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OPHTHALMIC

AND

OTIC MEMORANDA.

BY

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THIRD EDITION.

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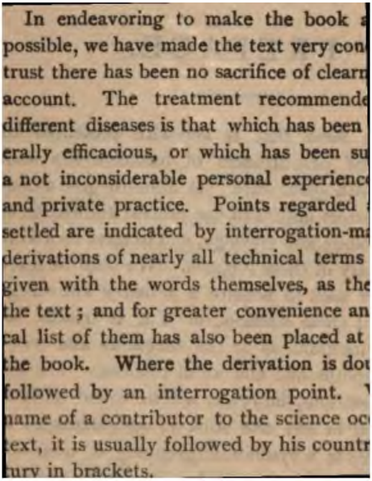
1885

PREFACE.

THE little book that is herewith presented to students and practitioners of medicine has been prepared with great care. It aims to give a concise and correct outline of our present knowledge of Ophthalmology and Otology, and to serve as a kind of Dictionary of these subjects. We shall be sorry if it is ever used to acquire a *primary* knowledge of either of these sciences, or if it is trusted for *complete* directions as to the diagnosis and treatment of ophthalmic and aural diseases. The anatomical portions, however, will be found quite as complete as in any one book in our language; as we have made a systematic grouping of what has hitherto been found only by consulting several works in English, German, and French. We believe our book will prove especially useful to those who are attending lectures upon the subjects of which it treats, but who are too busy during the lecture-season to consult the larger treatises. We hope, also, that even experienced general practi-



In endeavoring to make the book
possible, we have made the text very con
trust there has been no sacrifice of clearn
account. The treatment recommend
different diseases is that which has been
erally efficacious, or which has been su
a not inconsiderable personal experienc
and private practice. Points regarded
settled are indicated by interrogation-m
derivations of nearly all technical terms
given with the words themselves, as th
the text; and for greater convenience an
cal list of them has also been placed at
the book. Where the derivation is do
ollowed by an interrogation point.
ame of a contributor to the science oc
ext, it is usually followed by his countr
ury in brackets.

PREFACE TO REVISED EDITION.

THIS little work has met with so much favor, and so many editions have been called for, that the authors have attempted to thoroughly revise it, and thus to make it more worthy of the commendation of the profession. When first written, the desire for condensation led to a greatly abbreviated style, and to some omissions. These defects have been remedied as far as has been practicable, and the whole has been carefully revised. Many parts have been re-written, and thirty pages of new matter have been added. Some of the new material has been inserted by enlarging previous chapters, and some in the form of an Appendix. We believe that the book will now be found abreast of the times.

The authors would take this opportunity of repeating that the work is rather a dictionary of Ophthalmic and Otic science than a text-book; that it gives only a bare outline of the subject of which it treats; and that it is never to be recommended as a substitute for the larger works.

NEW YORK, March 22, 1880.

SINCE the publication of the last e
this book, my colleague, the junior aut
Edward Talbot Ely, has passed away.
timely death is a great loss to science, a
to his associates and friends.

A few changes have been made in th
this impression, and some important
required by the advances in ophthalmol
otology will be found.

D. B. ST.

NEW YORK, September, 1885.

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PART I.

OPHTHALMIC MEMORANDA.

CHAPTER I.

THE ANATOMY AND PHYSIOLOGY OF THE EYE.

THE visual apparatus consists of the eyeballs and their accessory parts for collecting luminous impressions, and the optic nerves for conveying them to the brain. Each eyeball forms a hollow, spherical box, blackened on its interior surface, having a system of convex lenses in front for forming images of external objects, and a special nervous membrane—*the retina*—behind, for receiving them. The whole is like a camera obscura. The light, passing through the cornea, aqueous humor, lens, and vitreous humor, is focussed upon the retina (which appreciates both intensity and color), and inverted images of objects are formed there. These impressions are conveyed to the brain by the optic nerves, and thence results the sensation which we call *vision*. The manner in which we gain our visual perception of an object, single and erect, from its two inverted retinal images, cannot be satisfactorily explained. The amount of light admitted to the eye is regulated by the re-

for vision at different distances,
focus of the rays of light is kept i
alike when we look at a far-off la
read a book. Only a small part
can be seen *distinctly* at any on
surrounding parts being more or l
on the other hand, the eye is so
its muscles as to command a ver
field. The two eyes act in perfec
and the images being symmetrica
on the two retinæ are combined i
impression. The two retinal
slightly different (each eye seei
responding half of the object mos
and from their union result o
solidity. Our ideas of *distance*
from the muscular efforts require
tinctly and from experience.

ORBITS.

seven bones: frontal, sphenoid, ethmoid, superior maxillary, palate, malar and lachrymal, three former being common to both orbits. ROOF formed by frontal and sphenoid; very thin; separates orbit from cranial cavity and frontal sinus; fossa for lachrymal gland at outer, anterior angle; depression (*fovea trochlearis*) for pulley of superior oblique muscle at inner angle. FLOOR, by superior maxillary, malar and palate bones; near centre, *infra-orbital groove* running from behind forward, converted into canal which opens on face $\frac{1}{6}$ inch below orbital margin, transmits infra-orbital vessels and nerve. INNER WALL, by superior maxillary, ethmoid, sphenoid and lachrymal bones; very thin, $\frac{1}{120}$–$\frac{1}{64}$ in.; anteriorly has *lachrymal groove* (for lachrymal sac) bounded in front and behind by *anterior* and *posterior lachrymal crests*. OUTER WALL, by malar and sphenoid; thickest ($\frac{1}{18}$–$\frac{1}{12}$ in.); presents *zygomatico-temporal* and *zygomatico-facial* (or *malar*) *foramina* for nerves of same name. In suture between inner wall and roof are *ant.* and *post. ethmoidal* foramina for ethmoidal vessels and nasal nerve. Between roof and outer wall posteriorly is *sphenoidal fissure* for 3d, 4th, ophthalmic division of 5th, 6th nerves, and ophthalmic vein. Between floor and outer wall posteriorly is *spheno-maxillary fissure* for infra-orbital vessels and nerve and ascending branches from sphe-

sels and nerve ; bases ¾ in. apa
formed by optic foramen and ca
funnel-shaped, runs between tw
lesser wing sphenoid, backwar
and inward to middle fossa of s
long, ¼ in. calibre ; transmits o
and ophthalmic artery. Orbits lin
osteum (or *periorbita*) continuous
and sutures with that of facial bon
dura-mater ; forms tendinous rin
tic foramen, giving origin to ocul
On periosteum is layer of conne
and fat, forming cushion for ey
nective tissue thickened to form
muscles, vessels and nerves, and
connecting different parts within
each other and with periosteum.
ciæ connect cartilages of lids w
orbit and with capsule of globe a
muscles of eye with funnel-like sh
starting from optic foramen, surr

tendons called *Tenon's capsule*. Rudimentary organic muscles found in orbit—*external, internal* and *inferior orbital:* supposed to strengthen union of lids with orbit; inferior, largest, $\frac{1}{25}$ inch thick, covers inf. orbital fissure.

OPTIC NERVES.

Origin in *thalami optici* and *corpora quadrigemina*, receiving filaments from *corpora geniculata, tuber cinereum, lamina cinerea, ant. perforated space, gray substance of brain, and post. columns spinal cord.* Fibres run forward, as *optic tracts*, beneath thalami and across crura to front of infundibulum, where they unite to form *optic chiasm* [Gr. χιασμα, *the figure* χ] in which they decussate. Chiasm rests on olivary process, sphenoid bone. From inner end of each tract fibres cross to nerve of other side, and supply inner half opposite retina. Greater part run directly, without crossing, to outer half retina of same side. On ant. edge of chiasm fibres run from one nerve to other—*ant. commissura arcuata*, or *inter-retinal fibres.* On post. edge fibres run from one tract to other—*post. commissura arcuata*, or *inter-cerebral fibres.** Vessels of tract and chiasm from pia-mater and brain. *Optic nerves* proper start from lateral portions chiasm, run divergent to optic foramina, thence

---

* *This form of decussation denied by some authors.*

separated from each other by conn
and vessels. Closely enveloped b
ma, a continuation of pia-mater—
—which sends processes between
nerve-fibres and blends finally wit
sclerotic. After entering optic fo
rounded by outer, fibrous she
sheath — continuous with dura-
with periorbita (p. 4) ; has inner la
closely adherent to it, correspon
ebral arachnoid ; about ¼ in. fr
splits into two, then into four la
pass into post. and middle layers
Sheaths joined together by loose
tissue and supplied by twigs from
muscular arteries. Space between
inter-vaginal, *sub-vaginal*, or *sub-*
At entrance into sclerotic nerve be
ner and fibres lose medullary sh
don-like processes from neuril
abundant, joined by fibres from

ish prominence about $\frac{1}{17}$ in. diameter. (p. 61). Nerve-fibres radiate from disc into retina in all directions. *Central artery of retina*, or *arteria centralis retinæ* [Lat. equiv.], enters nerve $\frac{3}{5}$–$\frac{4}{5}$ in. behind eyeball and runs forward in centre of nerve to papilla where it branches into retina. Enclosed in sheath of its own. Nutrient capillaries of nerve from ant. cerebral, central artery, and vessels of neurilemma ; anastomose in papilla with branches from short ciliary. *Central vein* accompanies artery, enclosed in separate sheath : leaves nerve a little nearer eyeball; empties into cavernous sinus, anastomosing with ophthalmic and so with facial. *Lymphatics* numerous in nerve and sheaths. Space between sheaths regarded as lymph-space, with which lymphatics of nerve and post. parts of eye connect. This space connects with arachnoidal lymph-space of brain.

EYEBALL, OR BULBUS OCULI.

In ant. part orbit to outer side of its axis, about equi-distant from upper and lower walls. Spheroidal form with segment of smaller sphere projecting from ant. surface. Antero-posterior diameter about .95 in. Transverse, .92 in. Vertical, .90 in. Weight, 6,3-8 grammes. Volume, about $\frac{1}{8}$ cubic in. *Anterior pole*, geometric centre of cornea. *Post. pole*, geometric centre of back part of globe, or *fundus* (Lat. for *bottom*). Optic axis,

the optic axis, and at an angle o
inner side of it. *Nodal point*, ce
vature of the refracting surface
little in front of the posterior su
lens. *Equatorial plane*, imag
through centre, perpendicular to
ing globe into *ant.* and *post.* h
Equator, line where eq. plane c
Meridional planes, imaginary p
ciding with axis. *Meridians*,
meridian planes cut surface.

Eyeball composed of 3 tunics : (
and *cornea*, (b) *uveal tract*, or
culosa, comprising *choroid*, *cilia*
iris, (c) *retina;* and 3 humors : (
(b) *crystalline*, (c) *vitreous*.

SCLEROTIC, OR SCLERA.

[Gr. σκληρος, hard.]

ant. border, $\frac{1}{60}$ in. thick. Foramen posteriorly to inner side of centre, for optic nerve-entrance (p.61); $\frac{1}{13}$ in. diameter. Terminates anteriorly in cornea, elements being transformed into corneal tissue; union by bevelled surfaces, sclera overlapping cornea anteriorly, and to slighter extent posteriorly; slight circular depression, or *sulcus*, around corneal margin. Outer surface somewhat rough, connected by loose connective tissue to sheath of globe, and anteriorly to conjunctiva by shorter filaments—*subconjunctival tissue.* Inner surface closely connected to choroid and ciliary body by layer of connective tissue, *lamina fusca*, containing pigment-cells. Sclera composed chiefly of connective tissue with elastic fibres, pigment-cells, and cells corresponding to corneal corpuscles, intermixed. Connective-tissue bundles have longitudinal and circular course interlacing to form dense mesh-work: form circular ring at ant. edge around cornea. Pigment-cells most abundant at inner surface. At ant. edge near inner surface is circular space surrounding cornea, *Schlemm's canal*, lined by endothelium and enclosing venous plexus: receives veins from sclera and from ciliary plexus; communicates with ant. chamber and ant. ciliary veins; regarded by some as venous reservoir for ciliary muscle. Sclera pierced around optic nerve entrance by long and short ciliary arteries, post. ciliary veins and short ciliary nerves: in

receives blood from ciliary syste
numerous, and form coarse ne
tains around optic nerve-entra
vascular zone (zone of Zinn or H
from twigs of short ciliary,
branches to optic nerve anast
those of central artery; thus for
connection between ciliary and
tems. On ant. surface, around c
vascular zone formed from episc
conjunctival branches of ant. cili
about $\frac{1}{6}$ in. wide; anastomoses w
tival vessels. Existence of ner
doubtful.

CORNEA.

[Lat. *cornu*, a horn.]

Transparent, highly-polished
forming anterior $\frac{1}{6}$ of external tu
jecting from sclerotic like segme
sphere. Ellipsoidal shape with r

(1.) *Conjunctival epithelium.*

(2.) *Ant. elastic lamina*, Bowman's or Reichert's membrane.

(3.) *Substantia propria*, or true corneal tissue.

(4.) *Post. elastic lamina*, or *Descemet's* membrane.

(5.) *Post. epithelium.*

Layer of conjunctival epithelium, $\frac{3}{2500}$ in. thick; consists of 2–3 layers transparent nucleated cells, superficial ones flattened, deeper ones oblong and placed perpendicularly to surface: passes over at edge (*limbus*) of cornea into epithelium of ocular conjunctiva. *Bowman's membrane* $\frac{1}{8000}$–$\frac{1}{2500}$ in. thick, firm, elastic, homogeneous basement-membrane, quite resistant to chemical agents. *True corneal tissue* about $\frac{1}{25}$ in. thick; consists of fine, highly-refractive, connective tissue fibrillæ united into bundles and these again into lamellæ, whose general direction is parallel to surface; space between fibrils, bundles and lamellæ is filled by semi-fluid, cement-like substance; in this is system of anastomosing spaces and canals containing serous fluid, network of corneal corpuscles, and wandering cells (?). Corneal corpuscles are flat or fusiform nucleated cells, with granular protoplasm, sending out anastomosing processes in all directions. Wandering-cells are lymphoid corpuscles endowed with amœboid movement. *Descemet's mem*

formation ; continuous at ma
mentum pectinatum of iris.
thelium, forms endothelium
membrane ; layer of flattened,
cleated cells. *Blood-vessels :* n
periphery, where there is a z
wide, of capillary loops formed f
branches of ant. ciliary arteries
with conjunctival branches ; v
into ant. ciliary. *Nerves :* 20–4
from ciliary, few from conjunc
enter through sclera ; latter
limbus. Just after entering co
dulla ; form very intricate net
Bowman's membrane and in a
layer, and smaller plexus nea
membrane ; fibres run forward a
superficial epithelial cells in m
settled.

UVEAL TRACT (p. 8

ness, $\frac{1}{300}$–$\frac{1}{150}$ in. Following layers from sclerotic inward :—

(1.) *Lamina fusca* [Lat. *fuscus*, dark], or *supra-choroidea*.

(2.) *Tunica vasculosa*.

(3.) *Membrana chorio-capillaris*, or *Ruyschiana*.

(4.) *Lamina elastica*, *vitreous* or *limiting membrane*.

Inner pigment-layer, often described with choroid, belongs to retina. *Lamina fusca* composed of connective tissue containing free nuclei, and nucleated, branching pigment-cells, brown and black; surrounds vessels and nerves passing forward to iris and ciliary body; leaves space—*supra* or *peri-choroidal* space—between choroid and sclera, lined by endothelium, communicating with Tenon's space through canals around venæ vorticosæ; considered as lymph-space. *Tunica vasculosa* consists of the larger arteries and veins, which run tortuous course and pass gradually into deeper capillary layer. *Membrana chorio-capillaris*, fine capillary network covering inner surface from optic nerve to ora serrata; meshes finest posteriorly. *Limiting membrane*, about $\frac{1}{50000}$ in. thick; structureless, hyaline membrane covering inner surface of capillary layer. Elements of choroid are bound together by *stroma*—a network of fibres in whose meshes are variously-formed pigment-cells and lymph

terior ciliary which become
capillary layer not passing be
rata ; recurrent branches from
and anterior ciliary. *Veins :*
merous ramifications and anas
into larger *venæ vorticosæ*, 4-
which pass out through sclera
carry off most of blood from uv
a small part escaping by ant.
Nerves from 3d, 5th and sympat
long and short ciliary, which p
around optic nerve-entrance ;
work in which many gangli
found.

CILIARY BODY is portion
between *ora serrata* and iris
continuation of choroid ; cons
muscle, covered by choroida
ciliary processes. *Ciliary mu*
choroideæ ; layer of unstriped m
situated in anterior and outer

angle are separate, circular bundles, the *annular muscle of Müller*; meridional and radiate fibres arise by tendinous ring from inner side of Schlemm's canal from which some pass forward into cornea; are connected with ciliary processes and choroid. Supplied by 3d nerve. Ciliary muscle is probably the exclusive agent in *accommodation*, but exact mode of its action is not settled: favorite theory is that of Helmholtz,—that meridional fibres draw choroidal border forward and circular fibres draw parts inward, thus relaxing zonula and allowing lens to become more convex from its own elasticity. During accommodation, the pupil contracts, the periphery of the iris moves backward, the lens is pushed forward, its anterior and posterior surfaces becoming more convex. The ciliary muscle was discovered by Brücke in 1846: first complete description by Müller in 1857. p. 245.

CILIARY PROCESSES; 70–80 parallel, meridional folds of choroid, rising gradually from behind forward, and forming plaited zone—looking like a ruffle—on inner surface of ciliary muscle: about $\frac{1}{10}$ in. long; possess same structure as choroid, without its capillary layer; covered internally by continuation of retinal pigment: joined by external (anterior) margins to ciliary muscle, internal (posterior) margins and bases being free and resting in corresponding depressions on surface of zonula; space about $\frac{1}{60}$ in. wide left be

side of globe, penetrate ciliar
with branches from anterior cil
culus arteriosus major at its an
smaller circle formed in sam
back; capillary plexus of m
from circles and also directly
arteries. *Arteries of ciliary pr*
from *circulus major*. *Veins* c
processes empty chiefly into ve
some joining with ant. ciliary.

IRIS [Gr. *iris*, a rainbow]
bends sharply in toward opti
from corneal margin, to form i
diaphragm with central openin
Pupil situated a little to nasal s
mean diameter $\frac{3}{25}$–$\frac{6}{25}$ in.;
pigment from bevelling off of
varies in size from muscular
dilated to maximum, edge
aqueous humor; when contra
anterior capsule of lens. I

even, divided by jagged line into two zones: (1) *pupillary*, $\frac{1}{25}$ in. wide, and marked by fine radiating folds; (2) *ciliary*, $\frac{3}{25}$ in. wide (allowing $\frac{4}{25}$ in. for pupil), and marked by 5 to 7 concentric folds; covered by layer of irregular cells continuous with those of Descemet's membrane. Post. surface covered by layer of pigment-cells, *tapetum* or *uvea* [Lat. *tapete*, *carpet*], continuous with pigment layer of ciliary processes; marked by 70–80 shallow, radiating folds. *Stroma* is loose, connective-tissue network, continuous with that of choroid and ciliary body, containing muscular fibres, vessels, nerves, round and stellate cells. In dark eyes, cells are strongly pigmented and often seen as superficial, irregular spots. In light eyes, cells are non-pigmented and color is an *interference phenomenon.* Layer of circular muscular fibres about $\frac{3}{500}$ in. thick and $\frac{1}{25}$ in. wide around border of pupil forming *sphincter pupillæ.* Radiating fibres, *dilatator pupillæ*, run from ciliary border toward pupil; form network within sphincter and unite with it. Muscular fibres lie near post. surface, being separated from uvea by thin limiting membrane. *Arteries* from *circulus major iridis* in ciliary muscle; walls very thick; run toward pupil, giving out branching network, and near pupillary margin form *circulus arteriosus iridis minor;* end in loops and pass into veins at edge of pupil. In albinos, color of blood

ciliary muscle into ant. ciliary.
3d, 5th, and sympathetic throu
short ciliary; form fine plexus
sphincter supplied by 3d, dilatat
thetic; sensitive fibres from 5th.
of iris *reflex* from action of ligh
and *accommodative* in unison
muscle; movements of the two i
taneous. Intersection of iris, c
cornea, and sclera, is called the

RETINA.

[Lat. *rete*, a net.]

Inner tunic of eye lying betw
and vitreous body from optic
serrata. Delicate grayish color,
parent: about $\frac{1}{75}$ in. thick at pap
thinner toward ora serrata, whe
$\frac{1}{200}$ in. thick. Composed of nerv
and modified connective tissue li
of brain. Layers from vitreous o

(9) *Rods and cones* or *Jacob's membrane.*

(10) *Pigment layer.*

(1) Hyaline memb. made up from retinal connective tissue : $\frac{1}{12500}$ in. thick.

(2) Transparent, homogeneous fibres, like those of brain, radiating from optic papilla in all directions, devoid of medullary sheaths; not sensitive to light: layer $\frac{1}{125}$ in. thick posteriorly, decreasing toward ora.

(3) Ganglion-cells with nuclei and nucleoli, having branching processes in variable number, some of which appear identical with nerve-fibres : layer about $\frac{3}{8000}$ in. thick.

(4) Finest nerve-fibres and connective-tissue network; fine granules of unknown nature : layer about $\frac{1}{1200}$ in. thick.

(5) Small round cells with large nuclei connected with radial connective-tissue fibres and nerve-fibres; processes from cells pass through molecular layer and unite with ganglion-cells (?) ; layer about $\frac{1}{1300}$ in. thick.

(6) Connective tissue, nuclei, granular substance, nerve-fibrillæ : layer about $\frac{1}{2000}$ in. thick.

(7) Ellipsoidal-shape, transversely striated, with long axis perpendicular to plane of retina; form nucleated enlargements of internal rod and cone fibres which run through this layer to reach (6) in which they arise (?). Inner part of layer devoid of granules—*ext. fibre layer* of Henle. Layer $\frac{1}{1000}$–$\frac{1}{800}$ in. thick.

(8) Membranous expansion of radial con-

nervous layer; probably termin
fibres; have striated appeara
lines of connective tissue surr
divided into external and inte
connected together by sheath a
highly refractive molecular m
fibres, *rod and cone fibres*, run in
and cones and appear to arise b
and finely-fibrillated expansion
cular layer: ext. granules are c
them. Existence of axial fibr
cones doubtful. Rods are cyli
long, $\frac{1}{8300}$ in. thick. Cones flask
$\frac{1}{800}$ in. long, $\frac{1}{8000}$ thick. Laye
thick.

(10) Hexagonal cells pressed
containing brownish-black pig
together by homogeneous con
send processes inward which
and cones—*pigment-sheaths:* c
ed externally to choroid. Pig

ula lutea [Lat. *equiv.*]—: most sensitive part and centre of direct vision. Situated about $\frac{1}{17}$–$\frac{1}{10}$ in. to outer side of centre of optic disc. Horizontally oval and of variable size, $\frac{1}{25}$–$\frac{1}{17}$ in. diameter. Has central fossa-like excavation, *fovea centralis*, $\frac{1}{125}$–$\frac{2}{125}$ in. in diameter. Nerve-elements of retina crowded together in macula at expense of connective tissue: ganglion cells and ext. granule layer thicker; rods replaced by closely-packed cones which converge toward centre; rod and cone fibres run diagonally or parallel to retinal surface; nerve-fibre layer interrupted, fibres passing around macula in curves: pigment cells increased, longer than broad, and darker color.

Ora serrata [Lat. for *serrated boundary*] :—anterior limit of retina situated just posterior to ciliary body; gradual disappearance of nervous elements here, leaving only connective tissue and pigment layers which are continued forwards over ciliary body as *pars ciliaris retinæ*.

Blood-vessels of retina : from central vessels of optic nerve which divide in papilla or just behind it; run chiefly up and down, generally two arteries and two veins in each direction: divide in arborescent manner and terminate in capillary network: do not pass beyond ora serrata: main branches lie in nerve-fibre layer, capillaries passing as far as internal granules; only capillaries at macula and no vessels whatever in fovea.

Biconvex, transparent, elastic
in hyaloid fossa of vitreous imm
hind pupil, enclosed in capsule
place by suspensory ligament.
face about $\frac{1}{7}$ in. from ant. surfac
axis a little to outer side of centr
More convex on post. surface th
radius curvature of former about
ter, about $\frac{3}{8}$ in. Curvature gre
zontal than in vertical meridian.
diameter; $\frac{33}{250}$–$\frac{39}{250}$ in. axis; weig
refractive index, 1.44–1.45. Co
cent. water, 35 per cent. soluble
cent. insoluble albuminous matte
fat, with cholesterine. *Capsule* is
elastic, homogeneous membrane
lens and divided into ant. and po
thickest anteriorly ($\frac{1}{2000}$ in.),
margin ($\frac{1}{6000}$ in.), and thinnest a
On post. surface of ant. capsule is
polygonal cells with round nuc

giving idea of *layers* when they are torn apart Each fibre curves around edge of lens, lying in both halves of same layer; greater part do not reach pole but join corresponding ones at acute angle, forming *seams* which run out from pole like rays of star and extend through whole substance of lens so as to divide it into sections. Centre of lens is unstratified, denser, and is called *nucleus*, surrounding part being *cortex*. Existence of cement-like substance between fibres doubtful. *Liquor Morgagnii* results from deliquescence of cortical layers and is wholly due to *post-mortem* change. Lens fibres called *tubes* by some authors. Lens has no vessels or nerves; receives nutriment by imbibition from uveal tract, vitreous and aqueous. In fœtus is covered by vascular sac from hyaloid artery, which also closes pupil—*membrana capsulo-pupillaris*. Lens grows by deposition of new fibres: cell-layer on post. surface of ant. capsule considered as matrix. *Suspensory ligament*, *zonula ciliaris*, or *Zonula Zinnii* [Zinn, Gottingen, 1755]: begins just behind ora serrata by fine filaments which run longitudinally forward intimately blended with retina, tapetum and hyaloid memb. of ciliary processes, some passing into vitreous. In ciliary region these fibres divide into two layers, anterior going to ant. and posterior to post. capsule of lens. Between these two folds and border of lens is triangular space—*canal of Petit*—closed durtoward pole (?).

VITREOUS HUMOR, HY
CORPUS VITRE

[Gr. ὑαλος, glass, and ειδος, like.

Fills interior of eyeball beh
ureless, gelatinous substance
and cells (chiefly in peripher
nective-tissue filaments. C
stellate (?), nucleated and fin
dowed with mobility (?). Vi
have a cortex, composed of c
and a nucleus which lies anteri
Canal of Cloquet, or *hyaloid c*
eter) runs through centre fron
contains hyaloid artery in fœ
rudiment sometimes persist
or hyaloid membrane ; bound
limiting membrane of retin
zonula and post. capsule of le

anterior and posterior chambers; weight $3\frac{1}{2}$–5 grs.; sp. grav. 1.0053; composed of water (96.687 parts), albumen (.1223 parts), salts and extractive matter. Refractive index, 1.3366.

Anterior chamber is space between ant. surface iris and lens and post. surface cornea. *Posterior chamber* is space between ant. surface lens, zonula and ciliary body behind, and post. surface iris in front. When pupil is dilated and edge does not rest on lens, the two chambers communicate.

MUSCLES OF THE EYEBALL.

Eye is moved by 6 muscles, 4 *recti* and 2 *oblique*. Centre of motion lies on optic axis 1.77 mm. (about $\frac{1}{14}$ in.) behind its centre. Rotary power greater inward and downward than upward and outward. Muscles of both eyes act in harmony, and movements are either *associated* (visual lines being parallel) or *accommodative* (visual lines convergent and ciliary muscle and sphincter of pupil participating). When all the muscles are at rest the visual lines converge toward a point 8″–12″ in front of eyes, angle between them being called the *muscular mesoropter*. *Muscle plane* is plane passed through centre of motion and line passing from middle of origin to middle of insertion of muscle. *Axis of*

ough base line and visual lines.
ridian is drawn perpendicular to
en eye is in primary position.
sition is that in which visual li
rizontal and parallel to median plar
ing erect; all other positions ar
ondary.

The 4 *recti* arise from tendino
ound optic foramen, run forwar
ntly, strike the sheath of the
st behind equator and pierce it ju
eir insertion into the anterior part
tic; tendons are flat and lines of
rtions are convex anteriorly. Mu
rrounded by sheaths from orbital c
ssue, which unite with Tenon's
is connection keeps muscles agai
nd prevents too great retraction of
fter division.

Superior rectus: O. upper edge o
I. sclerotic about ⅓ in. from

downward and inward; vert. meridian outward.

External rectus: O. external edge optic foramen. I. sclerotic about $\frac{1}{3}$ in. from cornea. Moves eye outward, not inclining vert. meridian.

Internal rectus: O. internal edge optic foramen. I. sclerotic about $\frac{1}{4}$ in. from cornea. Moves eye inward, not inclining vert. meridian. Is strongest muscle.

Superior oblique: O. $\frac{1}{25}$–$\frac{2}{25}$ in. anterior to inner edge optic foramen: passes forward to upper and inner angle of orbit, over pulley, thence outward and backward, beneath sup. rectus, to upper, outer, and posterior quadrant of eyeball, where it pierces ocular capsule and has fan-shaped insertion into sclerotic, about $\frac{3}{8}$ in. from cornea. Moves eye downward and outward, inclining vert. meridian inward. *Pulley* (*trochlea*) of sup. oblique, is tendino-cartilaginous ring attached to depression at anterior, inner angle orbital plate of frontal bone.

Inferior oblique: O. anterior, inner angle orbital part of sup. maxillary bone, just external to lachrymal sac: passes outward, downward and backward beneath inf. rectus, then upward and backward between ext. rectus and globe, and piercing ocular sheath inserts into sclerotic close to sup. oblique, about $\frac{2}{3}$ in. from cornea. Moves eye

main trunks, *superior* and *inf*
which run along roof and f
cavernous sinus ; have free a
facial in front ; blood can th
orbit in either direction. T
ciliary veins are very small an
only from sclerotic. There are
sponding to long ciliary arteri

LYMPHATICS.

Lymph formed in eyeball anterior to
out through anterior chamber and canal
are lymph-spaces in the meshes of th
forming the *iritic angle* (p 18) called the
They lie nearer to ant. chamber than
connect with both, and also with lymph
and sclera. Lymph formed in post
through channels near venæ vorticosæ
nerve. Spaces between choroid and s
roidal or *peri-choroidal*), between globe
of Tenon), and between sheaths of optic
nal and *sub-vaginal*) are regarded as ly

Third (*motor oculi*): supplies sup., inf., int. recti, inf. oblique, and levator palpebræ. Joined by motor nerves of accommodation and sphincter nerves of iris, which are supposed to have separate origin in brain. Sends branch to ciliary ganglion. Receives sympathetic filaments from cavernous plexus.

Fourth (*trochlear*, *patheticus*): supplies sup. oblique. Receives sympathetic filaments from carotid plexus. Sometimes blends with ophthalmic. Sometimes sends branch to lachrymal.

Sixth (*abducens*): supplies ext. rectus. Receives filaments from carotid plexus, from Meckel's ganglion and from ophthalmic.

Ophthalmic division of 5th: joined by sympathetic filaments from cavernous plexus. Gives off: (1) *Lachrymal*, which supplies lachrymal gland, conjunctiva, skin upper lid, anastomosing with branches from sup. maxillary and facial. (2) *Frontal*: *a*. supra-trochlear to corrugator supercilii, joining with infra-trochlear; *b*. supra-orbital to upper lid, corrugator and orbicularis, joining with facial. (3) *Nasal* or *naso-ciliaris*: *a*. ganglionic to ciliary ganglion. *b*. long ciliary, 2–3, joining short ciliary and going to ciliary muscle and iris; *c*. infra-trochlear to orbicularis, lids, conjunctiva, lachrymal sac and caruncle, joining branch from supra-trochlear.

Sympathetic branches: arise from medulla, cilio-spinal region, cavernous and carotid

Ophthalmic, lenticular,
lies in back part of orbit bet
and ext. rectus ; reddish col
eter ; receives root from c
sympathetic, long root from
mic, short root from 3d. Gi
iary branches 2–3 in number
into about 20, pierce sclerotic
optic nerve and go to cili
choroid, and cornea ; send
sheath of optic nerve.

Ascending branches sph
Meckel's ganglion, enter o
maxillary fissure, and go t
nerves and ophthalmic gangl

APPENDAGES OF T

EYEBROWS or SUPERCILI
Arched elevations of skin a
with row of short hairs ; se

EYELIDS or PALPEBRÆ [Lat. equiv.]: Two movable, protecting folds placed before eyes closing entrance to orbit. Upper lid about ⅘ in., lower about ½ in. high, measured on inner surface. Space between free margins called *palpebral fissure*. Outer angle of fissure called *external canthus*; inner angle, *internal canthus* [Gr. κανϑος, *angle of eye*]. Small space between lids and globe at inner angle called *lacus lacrymalis* [Lat. for *lachrymal lake*]. On edge of each lid about ⅙ in. from inner canthus is small elevation, *lachrymal papilla*, containing minute orifice, *punctum* [Lat. for *small hole*], the beginning of a lachrymal canal or *canaliculus*. Lids composed of skin externally, mucous membrane internally, and, between these, areolar tissue, muscle, cartilage, ligaments, glands, vessels, and nerves. Skin is continuous at edge of lid with conjunctiva. Is thin, lax, and contains a few fine hairs. Subcutaneous areolar tissue very loose, and contains sweat glands and hair follicles. *Tarsal cartilages*, formed of dense fibrous tissue, not true cartilage; lower one elliptical, upper crescentic and larger; orbital margins are thinned and pass into fasciæ (*palpebral* or *tarsal ligaments*) which connect cartilages to edge of orbit; free or ciliary margins thick and straight. Ligament thickened to connect outer angles of cartilages to malar bone and called *external palpebral* or *canthal ligament*.

sup. maxillary bone in ir
groove ; passes horizontally
lachrymal sac, sending apo
crest of lachrymal bone ;
two branches, one going t
each cartilage. *Meibomian g*
17*th cent.*], variety of cuta
glands imbedded in cart
upper lid, 20–30 in lower ;
blind tube into which open s
acini; tubes lie parallel an
inner lip free border of lid ;
secretion. *Conjunctiva* [La
join together] ; mucous men
reflected thence upon fr
passing slightly over edge o
conjunctivæ [Lat. *limbus*,
tinuous with integument, wit
Meibomian glands, canalicu
and nasal duct, and extend
mal ducts into lachrymal gla

and there; consists of connective-tissue basis covered by round, cylindrical and flat epithelium; surface traversed in all directions by furrows, and presents papillæ and papilliform elevations, and orifices of follicular glands; retro-tarsal folds present also conglomerate glands called *accessory lachrymal glands*, and papillæ are here more prominent. Ocular conjunctiva thin and loosely attached to globe; contains few papillæ and no glands; covered by epithelium which extends over cornea. *Blood-vessels* of conjunctiva chiefly from palpebral and lachrymal arteries; form thick net-work, indirectly connected through episcleral around corneal margin with ciliary system. *Lymphatics* numerous; form close network around edge of cornea. *Nerves*, from 5th pair, enter at inner and outer angles of eye; form thick plexus from which non-medullated fibres ramify beneath epithelium and end free—some apparently by club-shaped expansion.

Eyelashes, or *Cilia* [Lat. equiv.]: rows of short, thick hairs on free margins of lids, those of upper lid curving upward, those of lower downward; follicles lie in connective tissue upon cartilage; sebaceous glands connected with follicles lubricate cilia.

Muscles: orbicularis palpebrarum arises from int. angular process frontal, nasal process sup. maxillary in front of lachrymal groove, and ant. surface and borders tendo oculi;

subcutaneous areolar tiss
fibres unite by cellular rap
some passing into ext. can
malar bone. Is sphincter
portion having involuntary
by facial, supra-orbital a
nerves. *Tensor tarsi*, or
part of orbicularis lying b
Arises from upper 3d lachr
across sac and divides into
which inserts into each carti
some fibres surrounding ca
running along edge of li
Draws lid inward and press
globe; supplied by facial
palpebræ superioris arises
optic foramen, runs along r
inserted into fascia of uppe
edge of cartilage. Raises li
nerve. Organic muscular fi
inferior palpebral muscles.

conjunctiva; free anastomosis with angular, ant. temporal, lachrymal, and transverse facial. *Veins* empty into temporal and facial.

Lymphatics empty into facial and submaxillary glands.

Nerves; trifacial to skin and conjunctiva; facial, 3d, and sympathetic, to muscles.

CARUNCULA LACHRYMALIS [Lat. *caruncula, a little piece of flesh*]: small red body lying on semilunar fold in inner canthus: consists of 13–15 hair-follicles and sebaceous glands, with connective tissue and fat: covered by mucous membrane and has few fine hairs on surface: attached to Tenon's capsule and rectus internus muscle by tendinous fibres, which fact explains sinking of caruncle after division of muscle.

LACHRYMAL APPARATUS.

Consists of secreting portion, *lachrymal gland*, and *accessory conjunctival glands;* and conducting portion, *canaliculi*, *sac*, and *nasal duct*.

Lachrymal gland: composed of (1) *upper portion*—shape of almond, lying in fossa at outer angle roof of orbit, attached to bone by tarso-orbital fascia, under surface resting upon eyeball; longest diameter, transverse, about $\frac{3}{8}$ in.; weight, 11 gr; (2) *lower portion*—group small glands arranged in row just above fornix conjunctivæ. Ducts 6–12 in number, very

it lubricates, by winking of li
lects in *lacus*, and is forced int
orbicularis and Horner's mu
over cheek. [Under ordinary
tears evaporate, scarcely an
nose ; and they come mostly fro
so that extirpation of lachrym
not materially affect moisture

Canaliculi [Lat. for *little c*
mucous canals ¼–⅓ in. long an
diameter, lined by pavement e
enveloped by fibres of Horner'
gin at puncta, run nearly ho
open by common or separat
outer wall lachrymal sac be
ligament. *Lachrymal sac:*
end lachrymal canal between
rymal bone and nasal process s
oval form, flattened antero-pos
⅗ in. long and ⅙ in. wide. La
below level of lower inner

ward, curve varying in different subjects; $\frac{3}{5}$–$\frac{4}{5}$ in. long, about $\frac{1}{8}$ in. diameter; generally opens in inferior meatus nose, just below attachment inf. turbinated bone, sometimes lower: shape of opening varies with situation. Lined by thick mucous membrane covered with pavement and ciliated epithelium. Enclosed by very vascular network connective-tissue and elastic fibres, and, external to this, tendinous sheath, strengthened above by off-shoots from post. surface palpebral ligament and sheath of Horner's muscle.

Arteries and nerves of lachrymal apparatus are small twigs from neighboring trunks. Gland receives *lachrymal artery* from ophthalmic, and *lachrymal nerve* from 5th. Nerve governs secretion. [Hence flow of tears from mental states and from injury.]

SENILE CHANGES.

Are observed in most of the tissues of the eye. The *sclerotic* presents calcareous deposits, and a loss of elasticity favoring glaucoma. *Cornea* becomes smaller and thinner and loses tone; elastic laminæ become brittle and present warty elevations at margins. After 50 (rarely before), *arcus senilis* [Lat. for *senile bow*], or *gerontoxon* [Gr. γερων, *old man*, and τοξον, *bow*], appears, as result of fatty degeneration: begins on upper and lower margins in form of two superficial,

and ends join, forming ring.
goes atrophy, becomes rigid a
presents fatty degeneration
deposits; vessels become ath
capillary layer may be partial
membrana limitans thickene
changes occur in ciliary muscle
In *retina*, sclerosis of nerve-
connective tissue occurs, givin
appearance: pigment is blea
phied, causing uneven color: v
atheromatous. *Lens* increase
loses elasticity and becomes fla
assumes amber color, and mole
appear around it; changes i
cause radiating opacities: hya
is deposited on post. surface of
Zonula becomes weakened, fav
tion of lens.

The outer surface of the lids is easily seen. A magnifying glass may be used to examine their edges as to position, cleanliness, state of follicles, and curvature of lashes. Observe whether the lachrymal puncta are in proper position, and whether any catarrhal secretion can be forced out of them by firm pressure with the finger over the lachrymal sac. The inner surface of the lower lid is easily exposed by pulling the skin of the lid downward with the tip of one finger, while the patient rolls the eye upward. *To evert the upper lid*, have the patient direct his eyes—not his head—downward; grasp the central eyelashes between the thumb and finger of the left hand, and pull the lid a little downward and away from the globe; then place the tip of the thumb of the right hand upon the skin of the lid, well back from its edge, *so as to be beyond the upper limit of the tarsal cartilage;* then press a little downward with the thumb of the right hand and turn the edge of the lid upward by means of the lashes held with the left hand. The thumb of the right hand can then be removed and the lid held in its everted position by the left hand while it is examined, or while applications are being made to it. After a little practice it will be found easy to evert the upper lid in this way. Sometimes it will be found easier to turn it over a probe or pencil, than over the thumb. In small children, where the lids are swollen and congested by crying, or other cause simply separating them with the thumb ar finger of one hand will often cause their inn surfaces to be well exposed.

The examination of a child's eye is ofte very difficult on account of fear, obstinac photophobia, spasm of the orbicularis, et The child's head should then be firmly hel between the surgeon's knees (protected by towel), while its body is laid across the lap c an attendant, who must also hold its hanc and arms. The lids can then be separa ed by the fingers, or, if not, the upper or can be raised by an elevator. If this is nc sufficient, or if the eye is drawn out of vie by spasm of the superior rectus, the patien should be etherized. It is always best t make a satisfactory examination at the ou set, no matter how difficult or inconvenient may be to do so. The elevator is sometime required in other cases where there is grea swelling or inflammation of the upper lid.

When the front of the eyeball is *red*, it important to know whether the congestion superficial or deep. In the former case th redness will be conjunctival, and will b shown by a coarse network of vessels runnin over the sclerotic, or by a more uniform rec ness which nearly conceals all the white pa of the globe. If the congestion and swellin are not very great, the edge of the lower li rubbed against the globe by the finger ma be seen to move the vessels over the sclerotic, and to press the blood out of them. The inner surfaces of the lids will be congested also, and there will be a mucous or muco-purulent discharge, probably without much photophobia. In *deep congestion* (*ciliary congestion*), there is a rosy zone of fine straight vessels radiating from the edge of the cornea; they are immovable, and can be seen by close inspection to lie *beneath* the conjunctiva in the sclerotic. With this form of congestion, although it may be very slight, there will usually be found pain, dread of light, and a profuse flow of hot tears. This group of symptoms constitutes *ciliary irritation*, and it indicates an affection of the cornea, or of some of the deeper tissues. Of course the two kinds of congestion are often found combined. When the exit of the venous blood from the interior of the eye is impeded, large, dark, tortuous veins may appear running over the sclerotic, which they penetrate near the edge of the cornea. In certain cases of inflammation, it is important to know whether there is tenderness in the ciliary region—the region immediately surrounding the edge of the cornea. To test this point, have the patient look downward or upward, and make gentle pressure over this region with the tips of the forefingers placed against the lid. (See p. 45.)

Oblique illumination is very useful for examining the cornea, anterior chamber, iris,

ylight or lamplight up
inch convex lens. If a la
be to one side and some
eye examined, on a level
feet off. The observer's
path of the reflected ray
lens, the cone of light ma
erse all parts of the cornea
ances can be magnified l
another strong convex len
front of the examined eye.

The shape and movem
should be carefully noted
best observed by excludi
with a handkerchief, and
shading and uncovering
with the hand. The pup
promptly when exposed to
dilate more slowly when sl
taining its circular shape.
adhesions between the iri
suspected th

as an index of the intra-ocular pressure, is estimated by the degree of hardness of the globe, although this is influenced also by the elasticity of the sclerotic, and varies somewhat within health. The normal resistance gives a sensation which cannot be well described. The tension in disease varies between extreme softness and stony hardness. To test the tension, direct the patient to look down with closed lids, and placing both forefingers upon the upper part of the globe, make pressure and counter-pressure, much as when testing for *sense of fluctuation*. Always compare the two eyes. Bowman's signs are Tn. for normal tension, T+1, T+2, and T+3 for sucessive degrees of increased tension; T −1, T−2, T−3 for degrees of decreased tension; and sign of interrogation used in case of doubt. Instruments for measuring the tension are called *tonometers*.

The acuteness of vision (V or S*). It is supposed that the normal eye sees distinctly under a visual angle of five minutes—the visual angle being that enclosed between two lines drawn from the extremities of the object to the optical centre of the eye. The acuteness of vision is estimated by *Snellen's test-types*, which are so constructed that each number should be seen at corresponding distance under an angle of 5 minutes. No. 100

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* German, *Sehschärfe*.

which *d* equals distance at
seen, and D distance at w
to be seen. Thus, if type N
20 ft. $V=\frac{20}{20}$, or 1, the norm

type No. 50 is seen only at 2

No. 100 is seen only at 5 ft. V

the illiterate, figures, constr
principle, are used. When V
that type cannot be read, it i
ability to *count fingers.* T
which fingers can be counted i
V= fingers at 2 ft., etc. If this
there may still be *perception o*
tative when there is some perc
and outline, or *quantitative* wh
ence between light and dark is a

jects. It is found by formula $\frac{1}{A} = \frac{1}{P} - \frac{1}{R}$ in which P equals distance of nearest point (p) of distinct vision, and R distance of farthest point (r). It is really represented by that convex lens which, if placed at nodal point of eye, would give to rays coming from p a direction as if they came from r. For determining p and r it is customary to use Snellen's or Jaeger's test-types, selecting the smallest that can be distinctly seen. Although all rays which strike the eye are really divergent, those coming from an object 20 feet or more distant are regarded as practically parallel, and such a distance is called *infinite.* An eye which sees *with perfect distinctness* at 20 feet or more is said to have its far-point in infinity. An emmetropic eye when at rest is adjusted for parallel rays ; its far-point lies in infinity, $\frac{1}{R} = \frac{1}{\infty}$. If it can still see distinctly to within a distance of 6 inches, its near point lies at 6 inches, and $\frac{1}{A} = \frac{1}{6} - \frac{1}{\infty} = \frac{1}{6}$, or a convex lens of 6 inches focus. The accommodative power of such an eye is always expressed simply by $\frac{1}{P}$. A hypermetropic eye may also see distinctly at an

infinite distance, but only by exercising a p
of its accommodation; for near objects it m
use *more* accommodation than the emmet
pic eye; its total accommodative power
expressed by $\frac{1}{P}$ *plus* the amount of hyp
metropia. Thus, if $H = \frac{1}{24}$ and the near po
lies at 8 inches, $\frac{1}{A} = \frac{1}{8} + \frac{1}{24} = \frac{1}{6}$. In a n
opic eye the far-point corresponds to the n
opia; the eye *at rest* is adjusted for diverg
rays; for near objects it uses *less* accomm
dation than the emmetropic eye, and its
commodative power is $\frac{1}{P}$ *minus* the m
pia. If the far-point lies at 12 inches—that
if $M = \frac{1}{12}$, and the near-point lies at 4 inch
$\frac{1}{A} = \frac{1}{4} - \frac{1}{12} = \frac{1}{6}$. Thus, in the 3 examp
the accommodative power is the same
each, although the near point is differe

We distinguish: (1) The absolute range,
where one eye is used. (2) The binocu
range, $\frac{1}{A_1}$, where both eyes are used.

The relative range, $\frac{1}{A_2}$, or the range co
manded while the convergence of the visu
lines remains unaltered; embracing (*a*)

positive part, lying within the point of convergence, and (*b*) the *negative* part, lying beyond the point of convergence. To test the relative range, we may place the object at a definite distance, say 12″, and find through what convex and concave glasses it can still be clearly seen. The glasses alter the accommodation without affecting the convergence—the convex measuring the negative part of the relative range, and the concave the positive part, or the accommodative force held in reserve. To do near work comfortably, the positive part should be to the negative as 3 to 2.

The region of accommodation is the distance between the farthest and nearest points of distinct vision. Thus, if *r* lies at 30″ and *p* at 5″, the region is 25″. With the same range the region may vary greatly. (Vid. p. 48.)

Refraction of the Eye.—To determine this, it is necessary to have a case of trial glasses, comprising convex and concave spherical and cylindrical lenses. The rays of light are rendered convergent by the convex, and divergent by the concave spherical glasses. The cylindric lenses act like corresponding spherical glasses in one meridian, and like plane glasses (not bending the rays at all) in the meridian at right angles to this. The latter is called *the axis* of the glass. The strength *of a lens is* expressed by a fraction, whose

numerator is one, and whose denominator
the focal length of the lens in inches; the *pl*
sign being prefixed to the convex, and t
minus sign to the concave. Thus + $\frac{1}{6}$ repr
sents a convex lens of 6″ focus; − $\frac{1}{6}$ a conca
lens of 6″ focus. (See p. 245.) Cylindric lens
are designated in the same way, with the a
dition of a *c* placed after the fraction. Ea
eye should be tested separately, the other b
ing shaded with a screen without making an
pressure upon it. If the patient has norm
acuteness of vision not improved by conv
or concave glasses, he may be assumed to
emmetropic. If vision is below normal, an
improved by concave glasses, he is probab
myopic, and the glass which gives him t
best vision expresses approximately the degr
of his M. If he sees best through conv
glasses he is *hypermetropic*, and the gla
which affords the most acute vision express
approximately his *manifest hypermetropi*
a part of the defect, called *latent hyperm*
tropia, being almost always concealed by t
habitual use of the accommodation. Som
times the whole H. is latent; the patient m
have normal acuteness of vision and reje
all glasses, or he may even appear to s
better through concave glasses, so exalted
the action of the ciliary muscle. Latent
may always be made manifest by applying
solution of atropia (4 grs. to ℥i.), seve
times before the examination; it may als

detected with the ophthalmoscope. Where vision is not much improved by glasses, or the patient is uncertain in his choice of them, or miscalls many of the letters, *astigmatism* is to be suspected. Very often the sight cannot be raised to the normal standard with any glass, and then amblyopia is associated with the other conditions. (*Vide* Diseases of Refraction.)

Field of Vision is bounded by the most eccentric points which can be perceived while visual line remains fixed upon a central point; it comprises the parts seen *indirectly*, around the central object seen *directly*. To test it, place patient about 12″ from a blackboard, and have him direct the eye to be examined (the other one being covered) toward a small dot or cross marked in centre of board. Take a piece of chalk fastened to the end of a stick, and advance it slowly from edge of board, and mark spot where it is first seen—not as *chalk*, but merely as something white coming towards the eye. Repeat this in every direction and join the marks by a line. This maps out the *quantitative* field. By marking in the same way the points where the patient can first *recognize* the approaching object,—as, for instance, to count fingers—the *qualitative* field is obtained. By using bits of colored paper, as objects, the different *color-fields are* obtained. In the normal eye *blue has the largest* field, red the next, green

light, the patient is made tc
rected straight forward, and
is used in the same way as
termine the limits of the fi
should be shaded with the h
from one point to another, s
will not know from what di
its appearance A convenie
of testing the field is as follc
self 2 ft. from the patient, wi
level with his, and directly
testing his right eye, for ex
look steadily with this into
other eye of each being close
the test object midway bet
foot from each—you can ma
field, and at the same time
your own, which is suppose

The field may be concen
larly contracted, or interru

ἡμι, *half*, and ὄψις, *vision*]. Sometimes the outer half of each field is lacking—*temporal hemiopia*. Sometimes the inner half—*nasal hemiopia*. In the normal field there is always a blind-spot, corresponding to the optic disc, whose fibres are insensible to light. This is called the blind-spot of Mariotte, after the man who first described it. [Mariotte: France, 17th century.] Under ordinary circumstances it is not noticed, and occasions no inconvenience. Each point of the field corresponds to an opposite part of the retina. There are various instruments (*perimeters*) for measuring the field, and maps for recording it.

The perception of colors may be defective congenitally or from disease. It is best tested by worsteds, representing the ordinary primary colors and their different shades. A skein of worsted representing one of the primary colors—for instance, *green*—is laid out, and the patient is directed to put beside it all the samples which seem to him to be of the same color. The other primary colors are used in the same way. Tests which simply require the patient to *name* the colors are not considered reliable, for the reason that the color-blind learn to name colors correctly from the intensity of their illumination, etc. The worsted-test is known as Holmgren's. [Prof. Holmgren, 19th cent., Sweden.] (Vide p. 171.)

spot, and there is said t
in the latter case the im
other part of the retina,
fixation. In eccentri
presents the aspect of lo
of one corner of his ey
expressed.

Having examined eac
necessary to find wheth
in harmony. To do thi
derstand the significanc
action of prisms.

Diplopia [διπλοος,
vision], *or double visi*
lines are not fixed upon
ages are formed on d
two retinæ and there is
vision. For example, if
is fixed

image appears beneath that of other, etc. In short, double image always appears in direction opposite to that in which eye deviates. The images may be parallel or inclined to one another. Image of deviated eye is called *false*, that of normally-directed eye being *true* one. False image is fainter from being formed on a part of retina outside of macula, and therefore less sensitive. When images stand near together, false one is very distinct, and causes intense discomfort—when far apart, it is fainter and produces little or no annoyance, as patient soon ceases to notice it. A slip of red glass may be held before one eye to color one of the images, and so aid patient in distinguishing them. Flame of candle is one of the best test-objects. Diplopia may be constant, when there is fixed squint; or may only appear when eye is moved in certain directions, as when there is only slight inefficiency of a single muscle. Slightest form of it is where images are super-imposed and object appears surrounded by a halo. In certain refractive defects there may be two or more images formed in a single eye—causing *monocular diplopia* or *polyopia*.

Prisms.—A prism bends the rays of light in the direction of its base, according to size of its angle. If, while regarding an object, a prism is placed before one eye with its base inward, the rays from object will be deviated inward and image will be formed on retina

vision will thus be resto
is not too strong. Prisms
testing strength of mu
one which can be overco
taken as measure of their
ple, if while looking at an
a prism of 15°, with ba
placed in front of one eye
in front of each eye) bef
the double images is lost,
that prism as measure of
recti at distance named.
there is diplopia, strength
to fuse images becomes a
ation of visual lines. Fo
is crossed diplopia, and th
ed by prism of 15° plac
with base inward, we say t

strongest. This fact is made use of in prism-test for power of internal recti.

To examine *the action of the muscles*, patient may be directed to look at a pencil and to follow it with both eyes, without moving his head, while it is carried slowly in various directions through his circle of vision. If a muscle is inefficient, eye may often be seen to waver and lag behind its fellow when turned in direction of such muscle's action. For example, if right *externus* is weak, when pencil is moved to patient's right side the left eye will follow it, but right will not, or will do so in uncertain, faltering manner. The *internal recti* should be carefully tested as to their converging power: (1) Patient may look at pencil with both eyes while it is gradually advanced to within 4 or 5 inches, surgeon observing whether they remain fixed upon it or deviate outward. (2) While both eyes are fixed upon pencil, one may be covered by hand so as to exclude it from vision but still allow of its being watched: if its *internus* is weak it may be seen to roll outward as soon as its visual sensation is thus cut off. (3) Draw a fine vertical line upon piece of white paper and in middle of line make a round, black dot ⅓ inch in diameter. Let patient hold this at his ordinary reading distance and look at it, while a prism of 12°, base upward or *downward, is* held before one eye. Two *dots, one above* other, will then be seen. If

in latter case, by placing
base inward—before eye, t
brought into same vertical lin
of prism required for this
tion (or weakness of interni)
ent. If images are separate
homonymous, it shows defi
externi; prisms placed base
eye will bring them into sam
prism required measuring the
ness. Candle may be used
Most common defect of musc
is ordinary *squint*, which
covered at a glance. (*Vi*
Other defects often so slight
difficult of detection.

Binocular vision. [Lat.
oculus, *eye*.] Important to k

struction congenitally, as to be independent organs, binocular vision having ceased or never having existed.

THE OPHTHALMOSCOPE.

When light enters eye, part is absorbed and part reflected outward again through the pupil. The reflected rays retrace precisely the course by which they enter. To see fundus, observer's eye must be placed in path of these rays, without intercepting the source of light. Ordinarily this would be impossible. The difficulty is overcome by the Ophthalmoscope [Gr. οφϑαλμος, *eye*, and σκοπεω, *to look*] invented by Helmholtz, 1851. The instrument consists essentially of a small plane or concave mirror by which light is thrown through the pupil so as to illuminate the retina and choroid. Lenses for estimating refraction are on a disk on the back of the mirror. Examination should be made in dark room, with bright, steady light placed at side of patient's head corresponding with eye to be observed, on a level with latter and a little behind it, so that it will be in shadow. Light is received upon mirror and reflected thence into observed eye. Mirror thus becomes a source of light, and observer's eye placed behind the perforation can be directly in path of rays reflected from fundus of eye observed. Pupil

and the *direct* (or er
the surgeon holds mi
and illuminates eye o
about 12″: with the
biconvex object-lens i
observed eye so that
focus; lens may be st
ger against patient's
finger may be used to
quired. An enlarged,
dus is thus formed bet
er; image may be furt
a weaker object-lens (3
8–10″ convex lens behi
is best brought into vie
his eye a little toward
the macula, when he
In *direct method* no ob
observer

the media should be first observed from a distance of 12–18″. If observed eye is moved in all directions, and especially if pupil is dilated also, no opacity of media need escape detection. For detecting very minute opacities, a magnifying glass of 3 or 4 inches focus may be used behind the ophthalmoscopic mirror, taking care to have the part examined about at the focus of the glass. With the ophthalmoscope, opacities of the media usually appear black against a red background, while by oblique illumination they have a grayish aspect.

If the media are clear, the pupil is filled by a brilliant yellowish-red reflex from the retinal and choroidal vessels, more or less modified by the amount of pigment present. Appearances of fundus vary greatly within limits of health. Optic papilla (*vide* p. 6) generally appears as round or vertically-oval disc, about ⅙ in. to inner side of posterior pole, slightly prominent, of yellowish-white color (most marked on inner half), often bordered by pigment and by whitish connective-tissue ring, and marked by white striæ from trabeculæ of lamina cribrosa. Central vessels radiate from its centre into retina (*vide* p. 21), arteries of bright color and straight course, with light streak along centre; veins larger, darker, and more tortuous. *Venous pulsation appears on* disc, or, if not, is easily *produced by slight* pressure upon globe. Arte-

or has sharp edges. Reti
parent to be easily seen; s
eyes, especially in those of r
may appear as grayish film
should be found 2 diameters o
side of same, and on level wi
it appears as roundish sp
colored than rest of fundu
yellow spot, *the fovea centr*
tre. The region is marked b
blood-vessels. The pigment
seen as small dots uniform
fundus, and giving it a granu
In light eyes vessels of choroi
be seen as bright red bands
vascular spaces, and even fi
venæ vorticosæ may appear.
choroidal vessels may be co
and fundus may have mos
from abundance of pigment.

In what has been said of di

image, although object is but two or three inches away. If eye observed is not in condition assumed, direction of the rays is altered accordingly, and image naturally indistinct. In myopia, emerging rays are convergent: a concave glass must be placed behind hole in mirror to render them parallel before entering observer's eye, in order to give him a clear image. In hypermetropia a convex glass must be similarly used. Glasses thus required to give clear image—that is, to render rays parallel, as in emmetropia, become also a measure of existing departure from emmetropia, or of the refractive-defect. If observer is not emmetropic, he can correct his defect by proper glass, and then proceed as if he were an emmetrope. If he cannot fully relax his accommodation, he is practically myopic to amount used—that is, his eye is adjusted for divergent rays. The amount used is generally the same, and can be found by experiment. Having found this, observer should proceed as if he had myopia of that degree. In making calculations, observer's defect must always be allowed for.

Such, in brief, are the principles on which direct method becomes so useful for measuring refraction of observed eye. It is valuable aid to other means, not substitute for them. This method also used for making measurements in depths of fundus, as of inflammatory swellings, tumors, etc., on principle that a certain refraction corresponds to a ce length of antero-posterior axis. For ful planation of whole subject see *Mauth Lehrbuch Ophthalmoscopie*, chap. vi.; "*Determination of the Refraction o Eye with the Ophthalmoscope*," by Loring. An ophthalmoscope for estim the refraction of the eye, contains num convex and concave lenses. Loring's in ment was the first practical one. The fits upon the back of the mirror; and b tating it, any glass required can be bro opposite the sight-hole.

THERAPEUTICS OF THE EYE.

Comprise both local and general m Latter very important. Many ocular dis result from syphilis, rheumatism, Bright' ease, gout, etc., and will not recover wi appropriate general medication. Surg hands and instruments should be sc lously clean, and never carried from one to another without washing. Rags brushes used on one eye should never t another Poultices are a very common plication among those who prescribe themselves, and are almost always injur As a rule, they should be avoided. Lea tions are dangerous, as, in ulcerative dis of the cornea, they may be deposited as i ble precipitates in the corneal tissue, forming white opacities. Cleanliness; good hygiene; rest of eyes; avoidance of bright light, wind, dust, smoke, etc., are prescriptions of almost universal application in ocular diseases. In syphilitic affections the mercury is often given by inunction to secure a rapid effect. Anodynes are used as in disorders of other parts of the body. The following *local* measures are of very extensive use:

The protective or compress bandage: Used to exclude eye from injurious influences, to support and keep it at rest. To apply it, lay small piece of soft linen over the closed lids, and upon this spread charpie or cotton enough to fill the orbital hollow, regulating amount according to object in view, and being careful to distribute it in such way that its pressure will be uniform. This is held in place by flannel roller, 1½ inches wide, applied by alternating turns, first around forehead and then down under occiput and over eye, and fastened securely by pins.

Eye-shades: Often used as protection from light and wind. Best made of thick paper or pasteboard covered with black or blue silk and fastened by tape running around head.

Protective spectacles: These are of various kinds. Those with wire sides which exclude ventilation and keep the eye confined in an atmosphere of its own exhalations are objectionable.

The hermetical bandage : Sometimes ne ed to protect sound eye from contagious c charges of diseased one. Several differ forms are used. A simple method is to co eye with piece of soft linen and pad of ch pie ; fasten this with plaster and cover w collodion. Or, charpie may be covered w piece of oiled silk, and over this a piece linen, the whole coated with collodion a fastened by it to skin at edges.

Local blood-letting : Accomplished natural and artificial leeches. They applied to temples about an inch from ou canthus, or further back among the ha (which are first shaved), if it is necessary hide scar. Effect of artificial leech is rev sive, and vision sometimes worse immediat after. After-bleeding from leeching enco aged by hot applications, and patient kept darkened room for ensuing 12–24 hrs.

Cold applications : Best method of mak them is to have several pieces of soft lin about two inches square and one or two fo thick, spread upon cake of ice. One of th can be laid over eye and changed for anot as soon as it becomes heated. The clo generally need to be changed every 2 o minutes. They should not be so wet as allow water to trickle over the patient's f and down upon his clothing. *Dry c* may be applied by a small rubber bag fil ith pounded ice. Generally such ap cations are uncomfortable on account of their weight.

The cold douche is chiefly used in children who present great spasm of the orbicularis muscle and photophobia. The child's body and arms are firmly held while its face is forcibly dipped into a basin of cold water just enough to submerge the eyes, and is held there for a few seconds. The dipping may be repeated several times in quick succession.

Hot applications: Made by similar pieces of cloth wrung out of hot water, or by throwing hot water against eye with hand.

Heat and cold are not usually applied continuously, but rather for periods of 10–20 minutes, at intervals of an hour or more. Cold is usually proper at onset of acute external inflammations. Beyond this it is difficult to give absolute rules for their use, the patient's *sensations* being as safe a guide as any.

Mydriatics, or agents which enlarge the pupil. The *sulphate of atropia* (active principle of belladonna) is type of this class, and is the one most used. It contracts blood-vessels and paralyzes sphincter of pupil and ciliary muscle, putting eye in state of complete physiological rest. Applied directly by being dropped from dropper into lower conjunctival sac, or pencilled upon inner surface of lower lid with camel's-hair brush. Is absorbed through cornea and conjunctiva, and

thetic (?). Pupil first dilates
commodation gradually bec
Form employed is solution
water ℥i., and this is sufficien
use. Very weak solution (gr.
pupil without much effect on a
and is thus useful for maki
scopic examination. Atrop
and paper are sold, and are v
Patient should always be told
effects of drug, else he will be
accuse surgeon of "putting
In some cases atropine has p
shown by increase of inflamma
tation of lids and conjunctiv
eruption, etc., and has to be
(½ gr. sulph. zinc added to eac
will often prevent this.) Its
causes unpleasant feeling of dr
striction about the throat.
causes alarming symptoms

are of more limited application. Calabar bean is a type. It contracts the pupil and causes spasm of ciliary muscle. It will overcome weak sol. atropine, but not a strong one, and its effects are brief. *Sulphate of physostigmine* and *sulphate of eserine*—both alkaloids of calabar bean—are the myotics most commonly employed. Eserine is useful in much the same cases as atropine, excepting iritis, and sometimes agrees where atropine does not. It is said to contract the vessels, to lower the intra-ocular pressure, and to lessen diapedesis. (Vide Glaucoma.) It sometimes causes irritation. Both eserine and physostigmine have been highly recommended for suppurative diseases of the cornea.

Pilocarpine (the active principle of *jaborandi*) is similar to eserine in its effects on the eye, but is not so useful. Used hypodermically (hydrochlorate of pilocarpine, dose ⅛ to ⅓ gr.), as an alterative and absorbent, it is thought to act favorably in episcleritis, and for clearing up vitreous opacities. Used in this way it sometimes produces alarming prostration, accompanied by vertigo, nausea, and vomiting. It also causes sweating, salivation, and lachrymation.

Eserine, physostigmine, and pilocarpine are used locally in solutions of 1 to 4 grains to the ounce. *Atropinized and calabarized gelatine discs* are sold in the shops.

Irritants, astringents, and caustics;
lowing used most commonly:

Powdered calomel; applied by dustin
into eye from camel's-hair brush while
are held apart by fingers. Brush should
touch eye, and powder should be fine and
used in excess, lest it form lumps, and ca
too great irritation.

Ointments of *red* or *yellow oxide of m*
cury, or of *oxide of zinc* (each gr. 1–1
ʒi.), *solutions of tannin and glycerine;*
plied on inner surface of lid by brush,
small spatula, and spread over globe by l
Also applied to edges of lids for blephari
etc.

Crystals of *sulphate of copper* (*blue-sto*
and of *alum*, cut into smooth and conveni
form: *equal parts sulphate copper, nitr*
potash and *alum moulded into sticks* (*la*
divinus); *mitigated* or *solid stick nitrate*
silver: are applied to palpebral conjunct
by everting lids.

Solutions nitrate of silver (gr. 1–40 to
are applied to palpebral conjunctiva w
brush, or cotton wound on stick. After m
ing an astringent or caustic application, i
customary to wash off the surface treated w
a little water, or, in the case of nitrate of
ver, a little salt and water, in order to neutr
ize any excess of the remedy.

Lotions or *washes* (*collyria*) are of
given to patient for his own use at hor

The most common astringent collyria are those of sulphate of zinc, or alum, or copper (gr. 1–2 to ℥i.). For bathing the eyes, a solution of salt and water, or of borax and water (ʒi. to Oi.), is very useful. Where there are irritating discharges and sticking together of lids, simple cerate, vaseline, etc., are given, to be smeared along edges of lids.

A solution of the hydrochlorate of cocaine, of the strength of from 8 to 16 grains to the ounce, instilled every three minutes for fifteen to twenty minutes, is a local anæsthetic of the first rank (Koller, Vienna, 1875). It is used in the operation for cataract, artificial pupil, foreign bodies upon the cornea, with the best of results, and has largely displaced the use of general anæsthetics.

Exclusion from light. The amount of light to be allowed to a case of ophthalmic disease is often an embarrassing question. Many patients shrink from the light, when to indulge their propensity would be ruinous. The tendency of the laity is toward too much exclusion. As a general rule, the more light and fresh air, consistent with safety, the better for the case.

SURGERY OF THE EYE.

The following are the principal operations performed. The lids are held apart, when necessary, by a *spring-speculum*, and the eyeball kept in position by a *fixation-forceps*.

through cornea, and k
entered perpendicularl
by shortest route and
laminæ. When point
tered ant. chamber, it s
ward, and carefully wat
or lens. Incisions in ci
avoided, on account of
ophthalmia. Blood-clot
from incision on front o
bing lids over it; or by f

Paracentesis of corn
passing needle, or bl
knife, through cornea
allowing aqueous humor
alongside of instrument.
operations where anterior
a too rapid escape of flui
through fear of prola

Incision may be kept open by passing fine probe through it every day or two, and ocular tension so kept down until process of repair begins. This operation is done also for corneal *abscess*.

Trephining of cornea [Bowman, London, 1872] is done by an instrument specially designed for the purpose. A circular disc of corneal tissue is removed, Descemet's membrane being generally left behind, if possible.

Iridectomy [Gr. ιρις, and εκτομη, *cutting out*]. [Done by Wenzel, in 1780.] The iridectomy-knife is entered through cornea near its edge, carried on until incision is of desired length, and then withdrawn. Iris-forceps then passed through incision, made to grasp iris and draw it out, when desired amount is cut off by scissors close to lips of wound.

Iridodesis [Gr. ιρις, and δεω, *to bind*]. *Iridenkleisis* [Gr. ιρις, and εγκλειω, *to include*]. A small iridectomy-incision is made, and over this is laid loop of fine silk. Iris is caught by blunt hook and pulled out through incision and loop. Ends of latter then pulled and tied. Tissue thus strangulated drops off in 24–48 hrs. generally. Sometimes no loop is used, iris being merely left caught between lips of wound. Operation now seldom performed. Proposed by Critchett.

Iridotomy [Gr. ιρις, and τομη, *section*], or *Iritomy*. [Done by Cheselden, England, *1728.]* Done chiefly where iris has formed

ing a permanent op
pupil. Sometimes t
a knife passed thro
Special instruments
operation, such as
Wecker [Paris, 19th
Corelysis [Gr. κο
loosing]. [Wenzel.]
adhesions which have
and the capsule of th
made near corneal ma
of adhesion which it
Blunt, flattened hook
made to tear through
field's method.) Or, a
made near the edge of
grasped, by a pair of c
adhesion, which is then
made toward the pe
method.)

through peripheral portion of cornea. Aqueous humor thus comes in contact with lens matter and softens it so that it is gradually absorbed. Operation generally has to be repeated several times. Best to lacerate capsule and lens very slightly, especially at first sitting, else great swelling of lens-matter may result, causing injurious pressure. Pupil should be dilated with atropine before operation. Soft cataracts also removed through *linear incision* made at edge of cornea; may escape spontaneously as soon as wound is completed, or require to be *coaxed out* in same manner as hard cataracts, or to be removed by curette. When there is great swelling of lens after keratonyxis, it should be evacuated at once through a linear incision. Soft cataracts are sometimes evacuated by *suction*. A suction-instrument has been devised for this purpose, which can be passed through a small opening in the cornea.

The operation of Extraction is designed for the removal of hard cataracts. It has completely supplanted the old and dangerous operation of *reclination* or *couching*, by which the lens was pushed down into the vitreous humor and left there. The chief credit of introducing extraction is given to Jacques Daviel [France, 1745], although others had performed the operation before.

Flap-extraction is performed by a section made either upward or downward at margin

of cornea, so that about half cornea is c
prised in flap. Capsule next opened by
totome. Then gentle pressure is made
finger or a curette against globe opposite
so as to tip edge of lens forward into w
through which it escapes.

Graefe's modified linear extraction
brecht Von Graefe, Berlin, died, 1870
self somewhat modified since he first prop
it, is the most common operation for
cataract. The incision is smaller than i
flap-operation, and may be regulated by
size and hardness of the lens. The oper
is usually performed somewhat as foll
The point of a narrow-bladed knife (*a Gr*
knife) is passed through the sclera just
hind the edge of the cornea, and a little a
its centre, carried across the anterior ch
ber and out at a corresponding point on
opposite side. The first puncture is n
with the point of the knife directed d
ward toward the centre of the pupil, so
the inner lip of the wound may be as larg
possible. After completing the puncture
counter-puncture, the edge of the kni
turned obliquely upward and forward,
by a sawing motion, made to cut its way
emerging about at the upper sclero-cor
margin. A piece of iris is drawn out
excised. The capsule is divided by the
totome, preferably by a T-shaped incisi
by an incision along the periphery. Th

is tipped forward into the track of the wound, generally by pressure with the curette at the opposite corneal margin; then, by gently sliding the curette over the cornea, the lens is forced out. The incision is made either upward or downward. *Liebreich's operation* [*Liebreich, London, 19th cent.*]. Incision is made with narrow-bladed knife, is more transverse than in Graefe's operation, lying wholly in cornea, except puncture and counter-puncture, which are made in sclerotic about 1 mm. from its edge. No iridectomy is performed. A cataract-extraction is sometimes divided between two operations. At the first an iridectomy is performed; then, at some subsequent time, the lens is removed. This is called Jacobson's method [Jacobson, Königsberg, 19th cent.]. In certain forms of cataract the lens is extracted in its capsule by passing a curette behind it. Operations for *secondary cataracts* (see p. 134) consist usually in making a small hole through the membrane by tearing it with needles (called a *needling*) or forceps, or by cutting it with a knife or a special form of scissors.

The lens is sometimes removed in its capsule, by spooning it out (Pagenstecher) or by forcing it out, without an iridectomy, after having dislocated the lens with the back of the knife, while making the section (Roosa).

During all operations involving corneal incision, iris may fall forward into wound, and

cataract a few drops c
but if eye is closed a
recovery may occur w
ces. Still a loss of vitr
as an unfavorable occu
attended by detachmen
intra-ocular hemorrhag

Strabismus-operatio
botomy [Dieffenbach,
fold of conjunctiva and s
is seized by the forceps
and over insertion of t
This fold is snipped by
curved on the flat, wh
into the opening by a
made to thoroughly div
tival tissue about the in
Strabismus-hook is inse

ways of applying sutures for the purpose of lessening or increasing the effect of the tenotomy when necessary.

Advancement of insertion of a muscle.—An incision is made in conjunctiva, 1–2 lines from edge of cornea and over tendon of muscle. Tissues, including muscle (whose insertion is first divided), are dissected up from the sclerotic as far back as equator of eyeball. Flap thus formed is pulled forward and united by sutures to flap left standing at corneal margin, so as to cause the tendon to unite itself with the sclerotic at a point farther forward. Sometimes a piece of the muscle is excised so as to shorten it. If some conjunctiva is excised before bringing flaps together, effect is increased. Tendon of opposite muscle usually divided also, to increase effect. The operation is modified in several ways by different surgeons.

Bowman's operation for opening the canaliculi [*Bowman, London, 19th cent.*]. A fine director is passed into punctum and along canaliculus into sac, its groove turned toward free margin of lid, which is kept tense by being pulled outward with finger. Point of narrow-bladed knife then inserted into punctum and passed along director so as to lay open canal quite up to sac. Or a narrow, probe-pointed knife is passed into punctum and along canaliculus, which is divided by raising knife from heel to point, no director

Probing the nasal duct is dor
man's probes, which are of differer
bent to correspond with course of d
of lid is kept on the stretch as befor
the probe is passed along divided
until it is felt to strike hard inner
It is then raised into vertical po
convexity of its bend backward,
downward through sac, and then
outward, and forward through duc
When end of probe is *not in sac*,
ment of it will be seen to cause a
of overlying skin, and it will not
finger the sensation of striking
firm bony wall, as it does when in
sition.

The exact manner of passing
probes, the amount of force to be
can only be acquired by experienc

incision some recommend to put upper lid on stretch by pulling it toward nose and to divide upper canthal ligament by a nick with scissors, at right angles to incision, nick being made about two lines from temporal border of orbit [Dr. Agnew, New York]. A simple incision of the canthus without sutures is more properly called *canthotomy*.

Operation for Entropion.—The most common one is the Jaesche-Arlt operation or a modification of it:—A horn spatula is placed under the upper lid, and, by traction on the skin, the edge of the lid is rolled upward and outward. An incision is made along the edge of the lid, from near the punctum lacrymale to the outer angle, dividing it into two layers, the outer containing the cilia and their bulbs, the inner the conjunctiva and cartilage. The incision is about $\frac{1}{6}$ inch deep. A strip of skin, somewhat oval in shape, is then excised from just above the margin of the lid and running its whole length. The edges of the wound are united by sutures, and this rolls the anterior lip of the split border, containing the eyelashes, outward. Sometimes a strip of orbicularis muscle and a wedge-shaped piece of the cartilage are excised with the fold of skin. The bridge of skin containing the lashes is sometimes separated from the underlying tissue, so that it can be moved upward and so transplanted to a higher point as the edges of the wound in the integument are

drawn together. A canthoplasty is
also. Other operations are also do
deformity. The operations for *ectr*
numerous, and vary with the specia
ments of the case.

Enucleation or excision of eyeb
net, 1841] : Conjunctiva seized wi
and divided all around cornea quit
its edge, by circular incision, wi
pointed scissors, curved on flat. T
muscles picked up successively b
mus-hook and divided close to
Eyeball then drawn over to one si
ceps, and scissors (with curve to
ball) passed back along its surfac
nerve. Blades then opened and ma
vide nerve close to sclerotic. Us
hemorrhage is slight, and is easily
by pressing a sponge for a short t
the bleeding points. When it has
lids are closed and cold cloths applie
ing orbit with sponges, ice, etc., usu
less. A compress-bandage is use
there is a tendency to great swelling a
mosis of lids. By this operation orb
and muscles are left behind to fo
movable stump for artificial eye. I
conditions, as of malignant diseas
considerable piece of the optic nerv
times excised with the eyeball.

Artificial eyes may be worn aft
has cicatrized and all irritation ceas

best to begin to fit them a few days after the enucleation, so as to prevent contraction of the orbital cavity, and to give it a good shape. They should be worn at short intervals at first until parts become used to the foreign body. If *sympathetic trouble has existed in other eye*, take extra caution lest artificial eye be worn too soon. Must not be worn too long without renewal, as they become rough and irritating. Often give rise to severe conjunctivitis of stump, and sometimes to sympathetic irritation of other eye. Shells are made to wear over shrunken eyeballs where no enucleation is performed.

Some operations not described in this chapter will be found under their appropriate headings in other parts of book.

The after-treatment of operations requires special attention and study. After the principal operations upon the eyeball, it is customary to use atropine or eserine, according to indications, to apply compress bandage over both eyes, and to keep patient quiet in bed, with more or less seclusion from light. When desirable to keep eye closed for several days, the surgeon can judge of its condition, to a certain extent, from appearance of lids. If lids are red, swollen, and œdematous, this may be regarded as an unfavorable indication regarding the parts beneath. A purulent discharge is also a bad sign. If severe inflammatory reaction occurs, antiphlogistic treatment

usually require
water-dressing, and
Cocaine ranks perh
subduing the pain fr
traumatic or idiopat
in combination with t

CHAPT

DISEASES OF TH

THE ORBIT has cl
membranes and vesse
cranial cavity, and ten
eases, therefore, are no
They are not usually lim
but so classified for conv
tom common to many
ophthalmos or *protrusi*
may be hardly perceptil
lids cannot close, and ex
and allows contents of

cause orbital abscess, periostitis, hemorrhage, emphysema, fracture of bony walls, injury of eyeball, and even extrusion of it. Results may appear at once, or *not until some time after accident.* Fractures of roof and inner wall very dangerous from injury to brain. Foreign bodies should always be removed if detected. Best place for incision, either for exploration or removal, is through conjunctiva, between eyeball and lid. Outer canthus may be divided to give more room for manipulations. Parts should be kept at rest, and cold and leeches used to check inflammation. If eye is extruded it may be replaced and compress bandage applied. Incised and punctured wounds treated as in other parts.

PRESSURE UPON ORBIT, with tumor at upper inner angle, and displacement of eye downwards and outwards, is sometimes caused by distention of frontal sinus. Tumor, if left to itself, may burst into nose, orbit, or through upper lid.

EMPHYSEMA: Usually from fracture ethmoid cells or frontal sinus, or rupture lachrymal sac. Air enters cellular tissue of orbit and lids, causing elastic, crepitating swelling, and exophthalmos. Generally disappears under gentle pressure.

HEMORRHAGES: Chiefly from injury; sometimes spontaneous or due to straining. Ecchymosis may appear in lids and under con-

may be made where symptoms a
ABSCESS; ORBITAL CELLULIT
by wounds, foreign bodies, disea
cold, operations on eye, extensio
mation from other parts, sev
tutional disease. Symptoms aln
acute, reaching crisis in 8–14 days
hot, and swollen; intense pain, i
pressure against globe; fever, a
brain-symptoms. Exophthalmos
directly forward. Sight may b
from pressure on optic nerve,
cause engorgement and neuritis.
forms, fluctuation may be found b
and abscess may burst through l
junctiva. Prognosis guarded, on
possible necrosis, meningitis, and
injury of vision. Antiphlogistics
stages; if suppuration occurs, pou
incision through conjunctiva betwe
globe. Exploratory incision is pro

ophthalmos. Leeches and ice-compresses may be used in early stages.

PERIOSTITIS is generally limited and due to cold, injury, foreign bodies, or is secondary to inflammation of other parts. In *acute* form there is severe pain and *local tenderness on pressure against bony wall.* Swelling and redness of lids and perhaps slight exophthalmos—generally towards one side. Sometimes fever. Pus may form beneath periosteum, and necrosis may result. General treatment is that of cellulitis In *chronic* form, which is generally due to syphilis, symptoms are less marked. Pain apt to be worse at night. Nodes and exostoses may develop. Treatment should be that for syphilis.

CARIES AND NECROSIS result from injury, periostitis, cellulitis, syphilis, tuberculous and scrofulous cachexiæ. Cause sluggish, œdematous, inflammatory swelling of lids, which points and discharges foul pus. Fistulous opening marked by unhealthy granulations, and dead bone may be felt by probe. Pus should be evacuated as soon as possible and opening enlarged, when necessary, for removal or escape of exfoliated bone. Sinus should be kept open and clean until it can heal from bottom. In healing process there is apt to be cicatricial contraction of lid, leaving severe ectropion.

TRUE ANEURISM may arise from ophthalmic artery or its branches, causing protruinjury or disease with into orbital tissue. M aneurism. There is i ophthalmos. Latter and swelling of globe pulsating tumor appea sation stopped by pres ring noise in head, au stethoscope. Only tr false aneurisms is by c of carotid.

ANEURISM BY ANA erally congenital and fo often situated in subcut rior part of orbit. Cor ed vessels forming irr with pulsation and thri by pressure on carotid.

without sacrificing eyeball. It is often necessary, however, to remove latter also, even when considerable vision remains to it.

A form of exophthalmos of both eyes, without much loss of vision, associated with cardiac disturbance and enlargement of thyroid gland, occurs in *Basedow's* or *Graves' disease*, or *Exophthalmic Goitre*. There is a peculiar staring appearance of eyes, and the upper lid does not follow the globe normally in the downward movements of the latter.

CONJUNCTIVA.

FOREIGN BODIES upon conjunctiva cause marked irritation, congestion, and lachrymation, or flow of tears. [Lat. *lacryma, tear*]; together with spasmodic closure of lids, pain and *gritty* sensations. May be washed away by free flow of tears excited, or require removal. Ocular and palpebral conjunctiva must be thoroughly exposed and examined,—by magnifying glass if necessary (*Vide* p. 41). Foreign body easily removed by bit of soft cloth; or, if deeply embedded, by spud or forceps.

Sand, bits of broken glass, etc., may be washed away by stream of lukewarm water. *Sensation of foreign body may persist for some time after its removal.*

Injuries from lime, mortar, acids, hot fluids etc., cause excoriation, sloughing; and, in healing, cicatricial contractions. Eyes should be carefully washed with warm water, and *soothing applications* made—olive oil being

After-effec
Astringents to be av
exist. Atropine nea

ECCHYMOSIS: occ
sels by injury, or vi
sneezing; during scur
in course of inflamma
parent cause; or may
orbit,—usually some
Treatment by cold w
lating lotion (*Tinc. ar*

ŒDEMA: frequent in
spontaneously in debilit
ease. Compress bandag
wash are sometimes em

EMPHYSEMA: occurs,
of nose or rupture lach
crepitating swelling. Pr

CONJUNCTIVI

form may reproduce that form or a different one. First five forms contagious and infectious, and may occur epidemically. Differential diagnosis often impossible at first.

Catarrhal Conjunctivitis: Catarrhal Ophthalmia: Mildest form. Caused by injuries, exposure, bad hygiene, exanthematous diseases, &c.; may be secondary to other inflammations; in rare cases appears due to errors of refraction. *Symptoms:* Smarting, itching, sensation as of sand in the eye, lachrymation; increased vascularity, causing partial or uniform redness of globe and giving to inner surface of lids rough, velvety appearance: œdematous swelling of membrane and subjacent tissue, *chemosis*, [Gr. χημη, *a gaping?*] which, if severe, may rise above level of cornea causing it to appear sunken: redness, swelling and stiffness of lids; mucous or muco-purulent discharge, with tendency to gluing together of lids, especially in morning. Usually attacks both eyes at once. Amenable to treatment, and not very apt to invade cornea. (See p. 42.)

Treatment: In this (and in all other forms) extreme cleanliness as regards patient, and all towels, utensils, etc., used by him, with isolation if necessary; hygienic precautions and attention to general health. Locally, mild astringent lotion every few hours. A caustic applied at very outset may shorten attack. Cold applications in early stage.

pears as epidemic in w
etc., where people ar
Discharge purulent, thi
Great danger of invadin
ceration, sloughing, and,
in short time.

Treatment: Mild cas
catarrhal form. Severe
isolation, darkened roon
Pus should not be allo
Sometimes cleansing is
minutes, day and night.
fication of conjunctiva if
chemosis, canthotomy if
upon globe. When disc
tringent lotion every fe
caustic application, such
to inner surface of lids
Cold compresses continu
warm ones if more agreea
ropine, if cornea becomes

ner of origin, from any other purulent conjunctivitis. An extremely virulent, purulent inflammation, caused by inoculation from urethral discharge. May destroy eye in few hours.

Conjunctivitis in newly-born : Ophthalmia neonatorum [Gr. νεος, *new*, and Lat. *natus, born*] *:* catarrhal or purulent conjunctivitis of infants, usually appearing shortly after birth, and caused by contact with vaginal discharges of mother ; may also occur from other causes, as exposure, filth, &c., and not appear until several weeks after birth. All grades of severity.

Treatment: same as in similar inflammations of adult, regulated by severity of attack. It is believed by many that, in infants, caustics are needless and injurious ; and that a mild astringent application is sufficient.

Diphtheritic conjunctivitis: Occurs in course of diphtheria, and also results from same causes as other forms. Begins with great heat, redness, swelling, and *tenderness* of lids, with rigidity *from fibrinous infiltration.* Firm swelling of conjunctiva from same cause, and pale, smooth, glistening appearance of its surface. Sometimes grayish exudation-membranes on conjunctiva, which may be stripped off. Discharge of flakes of lymph. Advanced stage marked by softening of parts, from disappearance of fibrinous matter, and by discharge of pus. Great ten-

Treatment not very
presses, leeches, &c.,
gents, and caustics in
pia throughout. Sup
tem.

Granular conjunctiv
thalmia; Granular li
erally a result of one o
inflammations, and esse
dition, although someti
acute symptoms. Gran
tirely confined to palpebr
two kinds: (1) Enlarged
(2) "Frog-spawn granul
ies, looking like sago-gr
of lymphoid cells and co
varieties may be seen s
often mingled. Sympto
chronic conjunctivitis, n
If process not checked, c
of ulceration and

copper crystal being a favorite one. Nitrate silver, alum, and many other remedies are in common use. Applications lose effect, and need changing. Cases need regular treatment for long periods.

Phlyctenular conjunctivitis [Gr. *φλυκταινα*, *pimple*]: Characteristic of this form is small, yellowish-red elevation, or *phlyctenule*, on whose summit a serous vesicle forms, which bursts and leaves a small ulcer. One or several of these bodies may be present; they are generally situated near the margin of cornea, and run course in eight or ten days. The conjunctival congestion may be general, or partial—a triangular leash of vessels running up to each phlyctenule, its base pointing toward the retro-tarsal fold. Appearance of phlyctenulæ attended by burning pain, photophobia or dread of light [Gr. *φως*, *light*, and *φοβος*, *fear*,] and lachrymation. Often associated with phlyctenular keratitis (p. 101). Relapses very common.

Treatment: Particular attention to general health. Locally, atropine. In certain cases, application of mild irritant, such as calomel or oxide mercury ointment, &c.

PTERYGIUM [Gr. *πτερυγιον*, *a little wing*]: This is quite a common affection, which results from inflammation, and from constant exposure, such as is experienced by sailors, residents in tropical climates, on the Western prairies, etc. Consists of hypertrophy of con-

canthus, and rounded
or encroaching mor
Called pterygium *ten*
crassum [Lat. for *th*
thickness. Requires
extends upon cornea s
May then be removed
formed by dissecting g
and sclerotic to a poi
uniting conjunctival w
Transplantation ; per
off up to base, and th
incision made in conju
edge of cornea, retaini
Or (3) *Ligature;* by
growth at two or more
to cause strangulation.
pupil may be made b
clear part of cornea.

XEROPHTHALMIA,
EYE [Gr. ξηρος, *dry*, and

hesion of lids to globe. *Treatment* inefficient. Dryness may be alleviated by bland wash, such as milk or glycerine.

SYMBLEPHARON [Gr. *συν*, *together*, and *βλεφαρον* *eyelid*]. Adhesion between conjunctiva of lids and globe. Results from injuries causing excoriation and sloughing, or from long-continued inflammation. Adhesion may be complete, or only partial, in form of small bands or bridles. Difficult of cure. Various operations are done, aim being to separate surfaces and to keep them from reuniting.

ANCHYLOBLEPHARON. [Gr. *αγκυλωσις*, *stiffening*, and *βλεφαρον*, *lid.*] Adhesion between edges of lids. Has same causes as symblepharon, and sometimes associated with it. Requires same treatment.

TUMORS OF CONJUNCTIVA.

Pinguecula. [Lat. *pinguis*, *fat.*] Small, yellowish tumor, of fatty appearance, situated near corneal margin and chiefly seen in old people. Consists of hypertrophied conjunctiva and epithelium. Harmless. May be excised if desired.

Dermoid tumors. Smooth, yellowish tumors, covered with conjunctiva and, perhaps, short hairs. Composed of connective tissue and fat. Generally congenital. Excision is proper treatment.

rarely (p.153).

CORN

INJURIES AND WOUN kinds. The primary tre the eye at rest and allay applications. Atropine s eral times daily and cold tion is severe. Where e a few drops olive oil usef and allay pain. Compr used to restrain motion light. Beyond this, treatn to special requirements o

Foreign bodies: Very most common being part glass, gunpowder, etc. C according to depth to whic time they are allowed to ing efforts at removal a broad needle is sometimes passed into chamber so as to press upon foreign body from behind, and support it as it is being extracted. While removing foreign body eyeball may be steadied as follows: stand behind patient, with his head against your chest; have him look downwards, and press tip of your forefinger against sclerotic just above cornea, and tip of middle finger of same hand against sclerotic below and a little to inner side of cornea. Or lids may be held apart by speculum and eyeball steadied by fixation forceps. Cocaine is now used as a local anæsthetic. We may sometimes remove a small circular piece of the cornea, including the foreign body, with a trephine.

Injuries from chemical agents, burns, etc.: Apt to cause sloughing and permanent opacities. To be treated as similar injuries of conjunctiva (p.89).

Abrasion of epithelium: Readily seen as roughened, glistening facet. Very painful. Frequent cause is scratch from finger-nail.

Wounds: Chiefly dangerous from injury to deeper parts, which may fall forward (*prolapse*) into wound or escape altogether. Contused wounds apt to cause suppuration. Incised wounds generally heal readily.

KERATITIS [Gr. κερας, *cornea*] : INFLAMMATION OF THE CORNEA : Results from injuries, exposure, constitutional disease, mal-nutrition, inflammation of adjacent parts, etc. May

inflammation present. Atte
vision, ciliary irritation, zor
around corneal margin, p
lachrymation, contraction o
junctival congestion. Corr
swollen ; if ulcerated, it bec
ruptures, and allows deeper
or escape. If thinned or soft
forward from intra-ocular
staphyloma (p. 109). After r
opacities and alterations of c
main, with corresponding l
treatment of acute corneal i
cardinal rule *to avoid all irr*
tics, and to pay special att
and general health. Atropin
of eyes are always proper.
may be tried if symptoms

vessels traversing affected region. Epithelium may be shed, causing superficial ulceration and great pain from exposure of nerves. Under favorable circumstances tends to recovery. May run into one of other forms or be combined with them.

Phlyctenular keratitis: characterized by *phlyctenules* in superficial layers of cornea, like those of phlyctenular conjunctivitis; and often associated with latter disease. Phlyctenules appear as inflammatory nodules, singly or in groups on any part of cornea, but most often at margin; may be surmounted by vesicles which burst and leave small ulcers, or ulcers may result from loss of tissue of nodule without formation of vesicles. When eruption is limited, attendant congestion is partial; a triangular network of vessels is seen running towards phlyctenule, its base toward retro-tarsal fold and its apex at phlyctenule, if this is at edge of cornea. If phlyctenule lies some distance from edge of cornea, apex of triangle appears cut off at latter—a space of clear tissue intervening between it and phlyctenule. If disease is severe, vascular keratitis may supervene, vessels extending upon cornea quite up to phlyctenule. Pain and photophobia generally marked; latter symptom often being out of all proportion to amount of inflammation. Secretions from eye irritate and excoriate parts over which they flow. Disease most common

eczema, etc., in course
with conjunctivitis and
ment, these eruptions a
ceive special attention.

Interstitial, parenc
keratitis : Marked by
deeper layers of cornea,
diffuse cloudiness. Latte
margin toward centre
varies in degree from sli
opacity, as of ground gl
may be thicker in som
causing white or yellow
usually loses its polish, a
pled appearance from lo
sels may appear in subs
ning from margin towar
numerous as to cause br
travasated blood. Very
ceration. Apt to be tedi
of many months

neal tissue. Suppuration may be limited, or entire cornea may be changed into yellow, necrosed mass. If suppuration is enclosed by corneal tissue it forms an *abscess;* if superficial, an *ulcer*. Sometimes sinks down between layers to lower margin of cornea, presenting appearance called *onyx* [Gr. ονυξ, *nail*], or *unguis*, [Lat. for *nail*,] from resemblance to lunula of finger-nail. If pus breaks through into ant. chamber, it forms *hypopion*, (p. 138). By oblique illumination, and looking at cornea in profile, it is generally easy to distinguish between onyx and hypopion. Sometimes both coexist. Suppurative process may be attended with vascularity and very acute symptoms, or there may be no vessels, and little or no irritation. Latter form specially dangerous from rapid death and sloughing of tissue. Abscesses may be absorbed or burst open, or pus may undergo fatty or chalky degeneration, leaving dense opacity. When abscess opens, an ulcer results. *Ulcers* also occur superficially without precedent abscess. Are of variable size, shape and depth, and dangerous, according to situation and course. A very dangerous form is the crescentic marginal ulcer, which shows tendency to encircle cornea and cut off nutrition of central parts. In small ulcers, extending to Descemet's membrane, latter may bulge forward through ulcer like a vesicle, forming *keratocele* or *her-*

nia of cornea. Perforation generally fol
Larger ulcers frequently lead to staphy
(p. 109). If ulcer goes on to perforation,
is sudden escape of aqueous humor, wh
apt to carry iris forward into wound wh
may become firmly adherent during he
of ulcer, forming what is called *anteri*
nechia [Gr. συν, *together*, and εχω, *to*
If perforation is large, iris may pro
through it, and become adherent a
its edges, leaving staphyloma (p. 109). S
times after healing of ulcer, reaccumul
of aqueous humor and action of pup
muscles are sufficient to tear loose the
sions of iris, and allow it to fall back
proper place. Lens may also be carrie
ward with the iris against the perforation
when it returns to its position it is a
carry with it some inflammatory depos
its anterior capsule, forming *ant. cap*
cataract. Adhesions of iris and lens to
surface cornea may be so extensive and
that ant. chamber is never re-establi
Where sloughing of cornea is very exte
or total, escape of lens and vitreous,
atrophy of globe, may result. Ulcers
be filled up by transparent tissue and
without leaving trace. Slight, super
cloudiness may remain, which gradually c
up; or permanent, white, tendinous cic
may be left. During healing-process, ve
appear running over cornea to ulcer. Sup

tive inflammation may result from same causes as other forms. Is a dreaded result of operations involving corneal incision, especially in old and feeble. Bruised and lacerated wounds apt to cause it. One of the dangers of severe conjunctivitis. Occurs in paralysis of fifth pair, as *neuro-paralytic ophthalmia*. Such paralysis renders cornea anæsthetic, hence insensible to action of external irritants, and seems also to exercise bad influence upon its nutrition.

Treatment includes ordinary remedies for keratitis (p. 100). Special cases call for special means. Not customary to evacuate pus except in hypopion. Even large hypopion is often reabsorbed. Often essential to keep intra-ocular pressure reduced: done by paracentesis or iridectomy. Paracentesis may be repeated frequently. Hot fomentations are often useful, especially in asthenic form, where there is danger of rapid death of tissue. In neuro-paralytic form it is necessary to protect cornea by bandage. In deep ulcers it is better to perform paracentesis through their base than to allow spontaneous perforation. In indolent superficial ulcers Sæmisch's operation sometimes succeeds.

PANNUS [Lat. *pannus, a cloth*]:—is, strictly speaking, a non-inflammatory, superficial, vascular opacity of cornea—a neoplastic formation left by preceding inflammation. The term, however, is also applied to acute and chronic vascular keratitis, where formation of

crassus (p.96). In extre
have red, fleshy appe
continue for months or
change. Complete cu
rare. As a rule, opaci
times cornea is comple
dry, tendinous mem
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cause of pannus is tr
surface may then pr
those on lids. May be
continued irritation, su
bodies, inverted cilia
sphere, etc. Treatme
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this, irritant powders
used if no inflammati
remedies lose effect ar
or intermitted. As la
cases, inoculation wit
may be tried. This pr

larity, better the chances of success. Ulcers contra-indicate operation. Where fellow-eye is sound, it must be hermetically closed. Inveterate cases sometimes treated by operation of *Syndectomy*, which consists in removing a strip of conjunctiva and sub-conj. tissue all around edge of cornea so as to cut off blood supply from latter.

OPACITIES are frequent result of corneal inflammations with cicatricial deposit. Practically, divided into *superficial* and *deep*; former affecting epithelial layer, latter the parenchyma. Faint, superficial opacity called *nebula* [Lat. for *fog*]. Thick dense one, *leucoma*, [Gr. λευκος, *white*]. Cicatrix, combined with prolapse and adhesion of iris, is called *leucoma adherens*. White chalky-looking incrustations may result from metallic deposit, as where lead-lotion has been applied to an ulcerated cornea (p. 60). Opacities impair vision according to situation and according to alteration of curvature accompanying them. May necessitate constant straining for vision of small objects, leading to myopia and strabismus. If they prevent distinct retinal impressions, eye may become amblyopic from disuse and deviate outward (p.149). In children, may cause nystagmus. Many opacities disappear spontaneously, especially in young, healthy subjects. As a rule, the more recent and superficial the opacity, the better the chance of

filled up with trans
opacities resist all t
vision one of the oper
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transparent and of r
Where small part o
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οπη, *hole*] which cut of
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needles bound toget
points project evenly
is spread over opacit
perficial layers by

CICATRICIAL STAPHYLOMA [Gr. σταφυλη, *bunch of grapes*] :—generally the result of ulceration. Floor of corneal ulcer very apt to yield and bulge forward from intra-ocular pressure. During healing-process, bulging part is covered over with cicatricial tissue, and bluish-white protrusion, or staphyloma, is left. To this, iris may be partially adherent posteriorly. Or, if perforation occurs, iris may prolapse, close the wound, protrude through it, and form basis for the cicatricial deposit. Staphyloma may be partial or total, involving whole cornea. If partial, tendency is to increase. Lens may retain its position, or fall forward and press against post. surface of protrusion. Walls of staphyloma may be very thin and may burst; or may gradually thicken from fresh inflammatory deposit. Repeated attacks of inflammation and ciliary iritation may occur and lead finally to sympathetic trouble, especially where iris is involved and in state of constant tension. Staphyloma sometimes results from wounds of cornea and from cataract-incisions. In partial staphyloma, treatment aims to prevent further progress, to reduce protrusion already existing, and to improve vision. Repeated paracentesis, with methodical use of pressure bandage, or iridectomy followed by pressure, may succeed. In very extensive or total staphyloma, splitting or excision may be performed —lens being also removed. *Splitting* is done

base and allowi
lapse and cicatriz
[*Critchett, London*
passing several cur
silk through base of
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drawn through and s
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sympathetic ophthalm
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ciliary irritation as to

CONICAL CORNEA
cone-shaped staphyl
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Cornea is thinned and
ocular pressure is gene
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great distortion of images and reduplication of them. Slight grades often overlooked; high degrees may be easily seen, especially in profile. If eye is illuminated by ophthalmoscope, a central red reflex is seen surrounded by a dark ring, outside of which is a second bright red ring. By throwing light from different angles, side of cone opposite light is seen in shadow. If fundus is examined, everything appears distorted. *Treatment* unsatisfactory. Little improvement of vision from glasses. Stenopæic slit occasionally of use. All straining of eyes must be avoided. Operative treatment comprises iridectomy, iridodesis, trephining, and Graefe's operation, which consists in removing superficial flap from apex of cone and cauterizing part a few times with nitrate silver, so as to produce a shrinking cicatrix, and so flatten protrusion.

KERATO-GLOBUS : HYDROPHTHALMIA : BUPHTHALMOS [Gr. *βους*, *an ox*, and *οφϑαλμος*, *eye*] : Is uniform spherical bulging of entire cornea and neighboring part of sclerotic, generally associated with increased size of anterior chamber and tremulous iris and lens. Condition generally congenital; may appear after inflammation. Cornea may remain transparent or become cloudy, especially at margin. Causes great impairment of vision, changes in deeper tissues and often ultimate blindness. Treatment of little use. Iridectomy seems to do most good.

comprises atropine ; tou
trate silver ; bruising it
ceps to excite healing ;
iridectomy, etc. (See p.

SCLERO

EPISCLERITIS appears
ing on sclerotic near ed
on temporal side. Simu
shows no tendency to u
May be dull pain with
tenderness. Disease o
for syphilis and rheumat
pilocarpine locally, are r

STAPHYLOMA of scler
from inflammations whi

be necessary to remove eye. Post. staphyloma generally occurs in myopic eyes (p. 121).

WOUNDS of sclerotic dangerous, according as they implicate neighboring tissues and allow contents of eye to escape. Small wounds may heal readily. Cleanly cut wounds may be united by fine suture, any protruding choroid or vitreous being cut off by scissors.

IRIS.

SIMPLE WOUNDS may heal readily or set up iritis. A severe blow upon eye sometimes causes iris to rupture at its circumference,—*coredialysis* [Gr. κορη, *pupil*, and διαλυσις, *rupture*], or *irido-dialysis*, forming a secondary pupil, which usually remains permanent.

FOREIGN BODIES: Best way of removing one is by excising portion of iris in which it lies.

PROLAPSE OF IRIS is frequent result of perforating wounds of cornea (p. 104). If prolapsed tissue cannot be replaced it may be cut off, or treated by repeated puncture with needle, followed by compress bandage, in hope of keeping tumor collapsed and allowing edges of wound to heal over it. Atropine should be frequently applied. (See p. 67.)

IRITIS; INFLAMMATION OF THE IRIS: Caused by injuries, cold, syphilis, gonorrhœa, rheumatism, *extension* of inflammation from *other parts, etc.* Conjunctiva is suffused, and

rosy zone of fine subconjunctiv
pears around cornea, radiating i
from its margin. Iris appears
and discolored (light iris becom
and dark one brownish-red), a
ments are sluggish. This is c
peræmia and plastic effusion.
partly caused also by turbidity
humor from admixture with ly
Pupil contracted and its edges
glued by exudation to ant. cap
Such adhesions are called *poste*
[Gr. συν, *together*, and εχω, *to h*
may not be detected until atropi
when pupil dilates irregularly a
hesions at one or more points.
circumference of pupil is thus a
dition is called *exclusion of the p*
exudation encroaches upon *area*
dition is called *occlusion of th*
syphilitic iritis yellowish-red no
gous to gummy tumors, may
surface of iris. Sometimes
chiefly serous; intra-ocular te
creased; there is less tendency
pupil is dilated, and there is o
of lymph-particles on post. surfa
Condition is then called *serous ir*
titis, or *aquo-capsulitis*. Pain i
ble; may be very severe, and
forehead, temple, and side of
neuralgia), or may be entirely a

tophobia and lachrymation not always severe. Vision always impaired. From close connection between iris, choroid, and ciliary body, inflammation readily extends from former to latter and *vice versa*. If, during iritis, ciliary body becomes involved (*irido-cyclitis*) there is great tenderness over ciliary region—a symptom not present in simple iritis. If choroid becomes involved (*irido-choroiditis*) symptoms are all more serious; vitreous is clouded, and there is loss of vision and contraction of field not explained by iritis alone. This condition is most common in eyes which have suffered several attacks of iritis, leaving behind extensive synechiæ. Where cornea and iris are both inflamed, disease is called *kerato-iritis*. If synechiæ are left after iritis, iris is impeded in movements and constantly dragged upon by adhesions; free communication between ant. and post. chambers is interrupted, and natural balance of pressure destroyed. This condition tends to keep up chronic irritation and to cause frequent relapses, which may finally destroy eye. (p. 247.)

Treatment.—Perfect rest of eye and protection from light. Chief remedy is atropine. This keeps pupil dilated and away from lens so that adhesions cannot form; puts inflamed tissue at rest by paralyzing its muscles; contracts blood-vessels and lessens tension. Its action is resisted in inflammation and a strong solution should be used (2 to 6 grs. to ounce).

hesions have already fo
cause them to be stretche
are not too firm. Whe
tension and great irritatic
duce no effect until a pa
has been performed, and
cated in such a condition,
several times if benefici
pine acts better after t
brought under the influ
atropine produces poiso
must be stopped at onc
fomentations generally
is very acute. Essentia
enough to quiet pain. I
in other forms where the
to plastic effusion, pati
promptly under mercu
unction : and iodide of
at same time. Many
without cor

crease of fluids causes pupil to dilate?]: DILATATION OF THE PUPIL.—Chief causes are increased tension, paralysis of third nerve, irritation of sympathetic, disease of optic nerve and brain, action of certain drugs, such as hyoscyamus, belladonna and stramonium. Mydriasis generally confined to one eye, and may be uniform or partial. When not caused by drugs, pupil not dilated to maximum and has sluggish action.

MYOSIS [Gr. μυω, *to close.*]: CONTRACTION OF THE PUPIL.—Caused by irritation of branch of third nerve supplying sphincter of pupil, by paralysis of sympathetic filaments to dilatator of pupil (such as occurs in spinal lesions), by constant work at minute objects (as in watchmaking,) by certain drugs, such as calabar bean, opium, etc. *Treatment* of mydriasis and myosis depends on cause.

HIPPUS [Gr. ἱππος, *horse?*]: is chronic spasm of iris causing rapid, alternating contraction and dilatation of pupil, independent of stimulus of light. Generally associated with nystagmus.

IRIDODONESIS or TREMULOUS IRIS [Gr. ιρις, and δονεω, *to tremble.*]:—is marked by trembling of iris when eye is moved about. Caused by loss of support of crystalline lens from whatever cause.

CYSTS OF IRIS—rare, and generally result of some injury. Appear as transparent vesicles on surface of iris, attached by broad base

iris : *coloboma* [Gr
cleft iris : *corectop*
πος, out of place], c
pil : and *polycoria* [
pupil], or multiple

CH

RUPTURE OF TH
from blows upon eye
tion of other tunic
followed by hemorrh
with corresponding
Blood may be confin
itself, or penetrate b
or retina, or into vitre
hemorrhages seen with
as uniform red patche
feathery edges of ext
layer of retina. Som
may b

such means as cold dressings, compress bandage, and leeches to temple.

CHOROIDITIS: INFLAMMATION OF CHOROID:–Rarely independent, but usually associated with inflammation of iris, ciliary body or retina.

Disseminated or exudative Choroiditis:—marked by circumscribed, yellowish spots of exudation on surface and in stroma of choroid. Retinal vessels may be seen running uninterruptedly over them, and intervening tissue appear healthy. Exudations often appear first at periphery of fundus, and advance towards centre. May increase in size and coalesce, forming larger patches. Vitreous often contains opacities, and retina may suffer atrophy from pressure of exudation. When exudations are absorbed, corresponding portions of choroid become atrophied, allowing sclerotic to shine through and forming glistening white spots. Borders of these spots are black from collections of pigment, and blood-vessels are often seen running across them. Vision is impaired, and field contracted and interrupted by scotomata. Disease often due to syphilis. *Treatment:* Rest of eyes, and protection from light by blue glasses. In both syphilitic and simple forms mercury and iodide of potash are beneficial, combined with tonics, if necessary. Eyes may be leeched occasionally, if patient is not anæmic.

Suppurative Choroiditis. Panophthalmitis.

inflammation of cornea and
during typhus, cerebro-spi
pneumonia, puerperal fever
Is a most acute and violent
flammation involving whole e
conjunctiva swollen, red and œ
nea cloudy ; aqueous turbid ;
ward ; pupil dilated or blocke
vitreous, retina and uveal t
with pus ; tension increased a
painful and tender. Disease
in total destruction of eye a
globe. *Treatment:* Cold and l
atropine ; canthotomy to relie
lids ; paracentesis to relieve ter
exit to pus. Poultice sometime
and hasten suppuration.

A *serous* form of choroiditis
curs in connection with serous
toms of inflammation may be v
vitreous and aqueous are clou
fundus and im

sterior ; posterior staphyloma : Elonga-
of post. half of eye with stretching, inflam-
tion and atrophy of choroid and retina. Pre-
etiology disputed. Occurs commonly in
hly myopic eyes, leading to still further in-
ase of myopia. Occurs rarely in hyperme-
ia. Predisposition seems to be congenital,
exciting causes to be strong efforts of ac-
modation and convergence for near vision,
continued hyperæmia of posterior scleral
e. May be stationary or progressive. In
ner case, ophthalmoscope shows more or
regularly-shaped crescent at outer edge of
ic disc (or a zone extending nearly or quite
und disc) of glistening white color, from
rotic shining through the atrophied
roid, and with edges well defined, and
ged with pigment ; retinal vessels are seen
ning over it ; myopia does not increase,
eye is not painful or irritable. But if
ction is progressive, inflammatory symp-
s are added : edges of crescent are con-
ted and blurred ; additional white patches
ear about it and unite with original one ;
eous becomes turbid ; myopia increases ;
is irritable and vision impaired. Glau-
a, detachment of retina, or choroidal
orrhages may supervene. Sometimes
centic atrophy of choroid occurs without
staphyloma of sclerotic. *Treatment :*
active form, complete rest of eyes ; blue
ses ; avoidance of all causes of congestion ;

cold douche; leeches; atropine, etc.
Myopia.)

TUMORS OF CHOROID: chiefly variet
sarcoma. First appear as small n
which may increase till it fills globe,
through cornea, and appears externa
ulcerated, bleeding surface. In their
gress they may cause increased tensio
may thus be mistaken for glaucoma.
tend to recur and to invade neighborin
sues. *Treatment:* excision of eye as so
tumor is detected. If orbital tissue is aff
as much as possible should be remove
remaining surface cauterized.

TUBERCLES IN CHOROID: Occasi
found in acute tuberculosis. Appe
minute, circumscribed, rose-colored or
ish spots, and produce little or no lo
vision.

DEPOSITS OF BONE IN CHOROID: S
times found in eyes which have been
atrophied.

COLOBOMA OF CHOROID generally co
with coloboma of iris and ciliary body.
is usually bulging outward of correspo
part of sclerotic. With ophthalmosco
appears as white cleft in fundus, with
defined brownish edges, running from c
region toward disc. Retinal vessels
run straight across the white line, o
seen dipping into bulging portion o
rotic.

CILIARY BODY.

CYCLITIS. [Gr. κυκλος, *circle.*] **INFLAMMA-
ION OF CILIARY BODY** : Generally arises in
onnection with iritis and choroiditis, but may
lso come from injury. Diagnostic symptom
pain over ciliary region, especially when this
pressed upon. Also, zone of ciliary injec-
ion around cornea; photophobia and lach-
ymation; enlargement of veins of iris; in-
rease of tension; turbidity of aqueous and
itreous; loss of accommodation and impair
nent of vision. Exudation may be serous,
lastic or purulent. *Traumatic cyclitis,*
aused by wounds in ciliary region, foreign
ody in eye, dislocated lens, &c. May result in
atal suppuration and atrophy of globe in spite
f every precaution, and may also cause sym-
athetic inflammation of other eye. Leeches,
ot or cold applications, and atropine, may
e tried, but if disease progresses unfavorably
emoval of eye is advisable, to ensure safety
f other one. Cyclitis occurring in course of
ritis or choroiditis requires same treatment
s those affections, and may recover perfectly.

RETINA.

HYPERÆMIA is caused by prolonged ex-
osure to bright light; by fine work, espe-

more numerous than ally pulsate. Eye is i and dreads light. Ind cause, put eye at rest, glasses. Leeches and useful.

Passive venous conge obstruction to outflow of appear large, dark, tort

HYPERÆSTHESIA O When not dependent most commonly caused in fine work, by expo light, etc. The patient eyes, owing to dazzling se morbid persistence of lachrymation, spasm of iary neuralgia. Very ra toms there perceptible organic change. Most common causes are prolonged exposure to intense light, lightning-stroke, concussion of eye or head, disuse of eye (as in squint), neuralgia of fifth nerve, and old age. Distinctness of vision is impaired, especially in feeble light—*hemeralopia* [Gr. ἡμερα, *day*, and οψις, *vision*]. Treatment must depend on cause. Perfect cure often results. In anæsthesia from disuse, systematic exercise in reading with affected eye is often beneficial.

RETINITIS; INFLAMMATION OF RETINA: Caused by severe exposure to bright light or fine work; syphilis; Bright's disease; extension of inflammation from other tissues; embolism of central artery; injury, etc. Usually associated with inflammation of optic nerve (*neuro-retinitis*). May also be combined with inflammation of choroid and vitreous. Generally affects connective tissue primarily, and extends later, if at all, to nerve elements. Inflammatory product infiltrates tissue, and appears as exudation upon surface, being evenly spread over it or collected into irregular patches. Retina swollen and œdematous. Tissue and vessels may undergo sclerosis, fatty degeneration and atrophy. Extravasations of blood often occur; most common in inner layers, but may extend to choroid or into vitreous; may be absorbed or changed into opaque, degenerated mass; when very extensive, condition is called *retinitis apoplectica*. [Retinal

[illegible]
exudation, which soon
of papilla, and also nu
ing, stelliform spots sc
morrhages are nume
course of syphilis, th
white, punctiform opa
gion of macula, and he
to occur. In retinitis o
tis leucæmica) there
white patches, someti
strewn about periphe
macula—formed from
and red blood-corpus
yellow tint, and arteri
less. Suppuration o
occurs except in pano

Ophthalmoscopic app
Opacity of retina, va
that of fine mist or filn
patch of exudation.
the more the opacit

ternally appearances of eye usually normal. Vision impaired according to severity of inflammation, and extent to which nerve-elements suffer. Sometimes it remains normal, when ophthalmoscopic appearances are very marked. A very common complaint is that everything is seen through a mist or haze. Pain generally slight. Disease may run acute or chronic course, and end in recovery or in incurable atrophy and blindness.

Treatment: Complete rest of eyes. Blue glasses. Special attention to general health. Leeches to temple in acute stages. Small doses of mercury sometimes act well.

Retinitis pigmentosa; Pigmentary degeneration of retina:—Generally hereditary and associated with other bodily defects. Begins in early childhood, and runs very slow course, usually affecting both eyes. Often combined with *post. polar cataract.* Characteristic ophthalmoscopic appearance is a peculiar deposit of pigment scattered over retina, appearing as irregular, stellate, black spots, with branching processes (something like bone-corpuscles in form), and as small black lines, showing tendency to follow course of vessels. Retina and disc atrophied and vessels small. Choroid also atrophied in some cases. There is gradual contraction of visual field and increasing torpidity of retina. About the first symptom noticed is hemeralopia (p. 125). No treatment of any service.

DETACHMENT OF RETINA: Ca fusion of inflammatory material, between choroid and retina; by support from diminution in bulk by elongation of eye, as in myo mors beneath it; by concussion on eye, etc. May be partial o With ophthalmoscope an ordinary tachment appears as a tremulous, sac projecting into vitreous, w vessels bending over it, and surrou choroidal reflex. Very small d may appear as fine gray streaks. tachment no reflex can be obta fundus at all. Symptoms complai floating cloud before eye, metam and loss of vision in part of field c ing to detachment. Thus if low retina is detached, upper half of f absent, &c. Prognosis unfavorable. of detachment is to increase. O tionally it ruptures, or subjacent sorbed and retina falls back into some degree of sight is restored. chiefly expectant. Success has bee from keeping patient for long ti back, and also from operation needle in through sclera and ope as to allow fluid to escape and re back into place.

EMBOLISM OF CENTRAL ARTE *TINA*: Causes sudden blindness w or irritation. Optic disc appears blanched and retinal vessels reduced in size and more or less bloodless. Arteries may appear as small white threads; veins small and irregularly filled. Soon retina becomes opaque, except at fovea, which appears as cherry-red spot from choroidal reflex. Condition ends in atrophy of nerve and retina, and is irremediable.

EPILEPSY OF THE RETINA:—Is characterized by sudden dimness of vision, advancing from the periphery of the field toward the centre, until total blindness results, which lasts generally but a few minutes, and then completely disappears. The attacks occur at variable intervals, and affect one or both eyes. Condition is supposed to be due to spasm of retinal vessels. Affection is rare.

TUMORS OF RETINA: *Glioma* [Gr. γλια, *glue*]: is composed of round, spindle-shaped, and branching cells, with granular, intercellular substance, and originates in retinal connective tissue. Occurs almost exclusively in young children, and often unnoticed until far advanced. Appears as bright, yellowish tumor, projecting into vitreous. Surface vascular, and retina in vicinity detached. Eye may look normal externally and be painless, but vision is lost. As tumor grows, it fills globe, presses forward iris and lens, bursts through *cornea,* and presents externally *fungous, bleeding* surface—occasioning great

CRYSTALLINE

CATARACT : Is an opaci
caused by interference wit
thus result from senile in
ting disease, such as diab
especially of uveal tract, w
supply or extends to lens i
φακος, *lens*) ; or from inj
been observed as cause, b
action not understood. I
cataract occurs after 45.
any age, and is sometimes
forms described, but grea
is into (1.) *Soft* or *cortical*
below middle age, and
throughout. (2.) *Hard* o
occurring after middle ag
dense nucleus. Opacity
margin of lens and advan

tty or chalky consistence; or fluid parts
increase so that capsule is filled with
liquid. A cataract with fluid cortex
ıard nucleus is sometimes called a *Mor-*
ian cataract. *Traumatic cataract* is soft
act following injury and developing usu-
with special rapidity. Most frequent
s are wounds which perforate capsule
llow aqueous humor to reach lens-sub-
e, which becomes soft and opaque, and
swell to such an extent as to press upon
boring parts and excite dangerous inflam-
on. In more favorable cases it may be
y or partially absorbed. Traumatic cata
nay also result from simple concussion,
ut any rupture of capsule. Partial corti-
ataracts may occur and are often called
lar cataracts. They are usually not due
anges in capsule, but to changes in cortex
its inner surface. After iritis or per-
ng ulcer of cornea a deposit of lymph is
left on ant. capsule of lens (p. 104); su-
ial lens-matter just beneath may also
in its nutrition and become opaque,
intervening capsule remains transparent.
is called *ant. central capsular cataract*.
projects much above capsule it is called
midal cataract. An opacity of cortical
ance lying upon post. capsule, or a de-
of lymph upon latter from vitreous, is
l *post. polar cataract*, and is much less
ent. Sometimes a single layer of lens-

It may remain stationary o
Nuclear, *hard*, or *senile*
guished by a hard, central
surrounded by a less den
substance. As cataract pr
between cortex and nucl
and more evident, latter a
central patch of greater
yellowish color. Progres
often elapsing before cata
trogressive changes may o
Soft cortex may undergo
and chalky degeneration
comes harder. Capsule i
tough and adherent. Th
act has been applied t
where the color of the le

Symptoms: A fully
easily seen, as pupil i
opacity. Incipient or p
be seen by oblique illur

slightly denser at centre than at margin. In hard cataracts opacity presents yellow nucleus surrounded by grayish cortex. In pure lamellar cataract, opacity is uniform and sharply marked off from transparent border and overlying strata of lens. With ophthalmoscope, opacity appears as dark disc, and light shines through it from fundus. Vision impaired just according to degree of opacity. When cataract is congenital, or has developed in childhood, the lack of vision may cause loss of functional power of retina, or muscular derangements, such as strabismus and nystagmus (p.146). In cataracts appearing after puberty these effects seldom seen.

Treatment: Medicine accomplishes nothing except in way of improving general health, and so impeding progress of opacity. While cataract is maturing, vision may be temporarily improved by dilating pupil, by shading eye from light or by atropine. In partial cataracts which have become stationary, operation for artificial pupil may be performed to expose clear portion of lens. Complete cataract may be removed by one of several operations (p. 74). If degenerative changes have occurred, removal of lens is more difficult. Before operation, vision and field should be tested; for, if function of retina has been lost, operation is useless and unjustifiable. Progress of cataract may be hastened by opening capsule with needle, so that aqueous humor may act up traumatic cataract from rupture eye should be treated with atropi age, just as if a needle operation h formed. If lens-matter swells e should be evacuated at once thr incision. Chief bad results fro of cataract are suppuration of c irido-choroiditis, prolapse of iris, fect union of corneal wound. Af been removed, cornea is only ref face left, and strong convex glasse to give acute vision, except in where eye was very highly my operation. As accommodation i tacles give acute vision only at o and more than one pair is thus need lens has been removed from o and other is normal, spectacles used, because of very different r eyes. Still, eyes adapt themsel conditions, and work fairly togeth

Secondary Cataract: Is name opacities which appear in area of lens has been removed. [Also cataract following another disea Opacities may be in capsule or du deposit from iritis; or to partic matter left behind by operatio may cause impairment of vision b *wrinkled*, without being opaque. *for such* secondary cataract cons a hole in them by needles passed through cornea, etc. (See p. 77). If there is much lymph in pupil, iridectomy may be necessary.

DISLOCATION OF LENS; ECTOPIA LENTIS [Gr. εκ, *from*, and τοπος, *place*]: Generally results from injury, but may be spontaneous from weakening of suspensory ligament. May be complete or partial. In latter form, lens may be moved to one side, so that its margin crosses area of pupil, or it may be merely rotated on its axis. Iris tremulous, where support of lens is lost. Vision greatly disturbed. Artificial pupil may be made in more favorable place, or lens may be extracted, especially if it causes irritation. In total dislocation: (1) lens may lie in ant. chamber. (2) In vitreous. Is then apt to act as foreign body, and may cause sympathetic trouble. (3) Under conjunctiva. This only occurs where heavy blow has ruptured sclerotic, leaving conjunctiva intact. In all cases of total dislocation, lens should be removed at once if possible.

LENTICONUS or CONICAL LENS has been observed.

VITREOUS HUMOR.

FOREIGN BODIES lodged in vitreous usually *excite dangerous* inflammation and may cause

ANTERIOR

HYPOPION [Gr. ὑπο,
is a collection of pus
ant. chamber. Effusi
nea, iris or ciliary bod
or, if not too tenaci
by incision at lower ed

HYPÆMIA [Gr. ὑπ
blood] is an infusion
ber, and may result
rior part of eye, or fr
rupture of coats; or,
spontaneous. Best r
dage to keep eye quie

FOREIGN BODIES s

from pressure upon nerve and obstruction to its circulation. Occurs in connection with abscess, periostitis and tumors of orbit, basilar meningitis, tumors of brain, collection of fluid between sheaths of nerve, etc. Is called *ascending* or *descending*, according as it originates in eye and extends upward along nerve, or *vice versa*. Ophthalmoscopic appearances are due to hyperæmia, exudation and swelling. In marked case, disc looks red, opaque and prominent, with margins very indistinct, giving it a *woolly* appearance. Vessels are seen dipping into swollen mass and partly obscured by it. Veins distended tortuous and pulsating. This condition is called *engorged papilla*, *stauungs papilla*, [Ger. *stauen*, *to dam*], or *choked disc*. Vision impaired—but often less so than appearance of disc would indicate. Process usually ends in atrophy of nerve and permanent loss of sight. Neuritis generally associated with retinitis as *neuro-retinitis*. *Treatment* varies with cause, and this is sometimes beyond reach of any remedies. Rest, and blue glasses are always proper. Leeches, mercury, iodide and bromide of potash are of service in some cases.

ATROPHY OF OPTIC NERVE results from inflammation, and from other disturbances of innervation and nutrition, some of which are but little understood. Seen with diseases of brain and spinal cord; diseases of orbit,

her parts of fundus look natural, and vision
not impaired except by a slight enlargement
normal blind-spot. These facts serve to
tinguish opaque fibres near disc from an ex-
lation in that region.

AMAUROSIS.

AMAUROSIS [Gr. αμαυροω, *to render obscure*,]
d AMBLYOPIA [Gr. αμβλυς, *dull*, and ωψ,
]:—are names which were formerly much
d to denote the various conditions of
indness, before the diagnosis of ocular dis-
e was as exact as it now is. As they con-
y no definite idea of the nature of the dis-
se, they are objectionable wherever a more
act term can be used. The term *amblyopia*
ill found convenient to designate certain
nditions of impaired vision where no organic
nges can be seen to account for them.
ion is often thus defective where eye has
en long disused, as in strabismus—*ambly-*
ia from disuse, or *ex anopsia* [Gr. ανα, *with-*
, and οψις, *vision*]: in anæmia from severe
ness or hemorrhage—*anæmic amblyopia* ; in
oholism—*amblyopia potatorum* [Lat. *pota-*
drinker]; in uræmia; lead-poisoning;
ssive use of tobacco; from exposure
ged glare, as in snow-blindness, and
ia ; *from* irritations of fifth nerve,

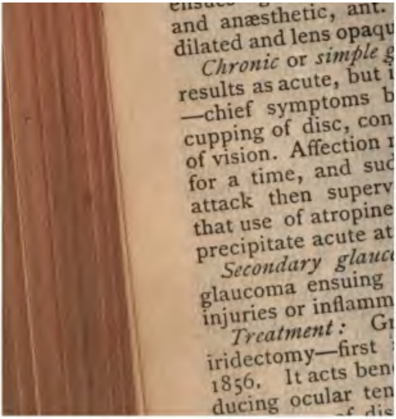
cases vision is resto
orates, and atrophy
rent.

GLA

GLAUCOMA [Gr.
greenish reflex some
ARTHRITIC OPHTHA
ous disease of eye oc
dle age, and which, i
curable blindness.
crease of intra-ocular
of tunics and destruc
Exact etiology not de
to be due to inflamm
version of nerve influ
Rigidity of scleroti

of visual field, *most on nasal side;* slight increase of tension; ciliary neuralgia.

Acute inflammatory glaucoma presents all symptoms of severe internal inflammation. There is ciliary and conjunctival congestion; photophobia; lachrymation; aching pain in globe and over head, with perhaps fever and vomiting; cornea cloudy; iris pressed forward and ant. chamber shallow; pupil dilated and perhaps presenting greenish reflex; aqueous and vitreous turbid; tension increased, even to stony hardness. Vision much impaired. If fundus can be seen, arteries are found to pulsate spontaneously or from slight pressure on globe, veins are dilated, tortuous and pulsating; and small hemorrhages may appear in retina. If tension has existed long enough, optic disc is found cupped in characteristic manner: excavation extends to margin of disc and its edges are abrupt, steep, and sometimes undermined; nerve is of bluish-gray color, increasing in intensity towards periphery: retinal vessels appear distorted or interrupted where they pass over edge of cup: if object-lens (examining by indirect method) is moved sideways, a parallax is obtained, margin of excavation appearing to move over its centre "like a frame over a picture." Severity and course of disease very variable. May be very rapid, destroying sight in a few hours—*glaucoma fulminans* [Lat. *fulmen*, *lightning*]; or, acute symptoms may subside,



ensues
and anæsthetic, ant.
dilated and lens opaqu
Chronic or *simple g*
results as acute, but i
—chief symptoms b
cupping of disc, con
of vision. Affection r
for a time, and suc
attack then superv
that use of atropine
precipitate acute at
Secondary glauc
glaucoma ensuing
injuries or inflamm
Treatment: Gr
iridectomy—first
1856. It acts ben
ducing ocular ten

globe; inflammations involving ciliary body. Seen most commonly in young. Period of occurrence variable: may appear shortly after injury or not until many years have elapsed—injured eye having perhaps meanwhile atrophied to a shrivelled stump. Danger of it cannot be considered as past so long as injured eye remains, especially if this shows any tenderness or irritation. Disease may come on very insidiously, and is often unnoticed until beyond hope of aid. There is a condition called *sympathetic irritation* quite different to sympathetic ophthalmia—regarded by many as premonitory stage of it. In this condition, eye is irritable and perhaps slightly injected; there is photophobia, lachrymation and neuralgic pain; power of accommodation is diminished, and eye is quickly fatigued by fine work. These symptoms may recur repeatedly and pass off leaving no organic changes, and they cease completely after other eye is removed. *Sympathetic inflammation* attacks iris, ciliary body, choroid, retina, and vitreous—extent to which these different structures are involved varying in different cases. Tendency is toward rapid plastic effusion, which glues different tissues together and destroys them. Iris is bound to lens and becomes degenerated and rotten; it may be drawn backward by the adhesions or bulged forward by exudation behind it. Masses of lymph may fill pupil or be seen floating in

almost always te
Tension increased
as eye degenera
mainly preventive,
disease is once est
which there is slig
ophthalmia is alwa
cially if patient lives
cal aid. If injured e
may be left, but shou
enucleated the mom
irritation. If disease
eye should be at onc
of benefit are then s
eye and protection
atropine frequently a
food, are all importan

—

MUS

STRA

anything which prevents binocular vision (cataract, corneal opacity, &c.) in which case the excluded eye yields passively to muscle which happens to be strongest; or from paralysis of muscles. Chief forms are *convergent strabismus* (eye deviating inward), and *divergent strabismus* (eye deviating outward.) An upward squint is called strabismus sursumvergens; a downward squint, strabismus deorsumvergens. Squint confined to one eye (*monolateral*); or may appear sometimes in one and sometimes in other (*alternating*). Range of motion of squinting eye may be curtailed, or it may be as great as ever—only displaced toward side of contracted muscle--as is usually the case in alternating squint. To determine which is squinting eye, direct patient to look at your finger held before him, and cover each eye alternately with your other hand. If uncovered eye remains fixed on object when other is covered, it is eye usually used for fixation. If it has to move to bring its visual line upon object, it is one which usually squints. Deviation of squinting eye when sound eye is fixed upon object is *the primary deviation*. Movement which sound eye makes when covered with hand, while squinting eye is made to fix its visual line upon object is *the secondary deviation*. When primary and secondary deviations are equal, and squinting eye accompanies healthy one in its movements, strabismus is called con-

fixed upon object, and
other eye fixes object.
this distance called *st*
squint is monolateral,
quently amblyopic, from
of unconsciously suppre
so as to be rid of the dip
ing strabismus, first one
the other, and vision
equally good. Strabis
panied by diplopia, but t
later (p. 54.)

Convergent or *Intern*
to hypermetropia in g
In H. the accommodati
into excessive action, a
ciated with increased
tempting to increase ac
gain clear vision, one e
first, squint may be *pe*
when close work is un

from excessive use. It may also occur from division or paralysis of external rectus (p. 150).

Divergent Strabismus ; is most frequently accompanied by myopia. In myopia strong convergence often required, yet difficult from shape of eyeball, and internal recti become strained and weakened allowing eye to deviate outwards (p. 162). Also, when one eye is blind or very defective the impulse to binocular vision is lost, the internal rectus grows weak and divergence occurs. It may also be produced by division, paralysis, or defective innervation of opposite muscle (p. 151).

Treatment for concomitant squint (which must always be carefully distinguished from the paralytic) consists in dividing tendon of shortened muscle. This weakens muscle by allowing its tendon to recede and acquire new insertion further back on sclerotic, and so, indirectly, strengthens opposite muscle. Where deviation is great, it is often necessary to operate on both eyes, to obtain full correction. After operation (p.78), suitable glasses should be worn to correct the refraction and prevent recurrence of the squint.

PARALYSIS OF THE NERVES SUPPLYING THE MUSCLES :—One or more of the nerves may be affected, and paralysis may be total or partial (*paresis*). A fixed squint may result; or the trouble may be difficult to de-

disease, from syphil
syphilis being most f
examining muscular
p. 57. The diplopia
muscle is affected,
accompanies each
paralytic squint is p
from concomitant fo
deviation is greater
being just equal to
that deficient innerv
demands a greater e
eye into a given po
flected upon healt
causes a disproporti

Paralysis of thir
quent. May be co
one or all of the b

be thus confined to one or two muscles. If branch to int. rectus is paralysed there is deficient mobility inward and crossed diplopia, images being on same level and parallel. If sup. rectus is paralysed, there is impaired motion upward and inward, and diplopia occurs above horizontal line, images being crossed, and diverging at top, false one standing above true. If inf. rectus is paralysed. there is impaired motion downward and inward, and diplopia appears below horizontal line. Images are crossed, false one standing below true, and they converge at top.

Paralysis of fourth nerve: paralyses sup. oblique muscle. There is impaired motion downward and outward, and homonymous diplopia below horizontal line. Images converge at top and false one stands below true.

Paralysis of sixth nerve: paralyses ext. rectus. There is impaired motion outward and homonymous diplopia, images being on same level and parallel.

Treatment of paralysis must depend on cause. Electricity sometimes of use. To relieve patient from diplopia, affected eye may be covered with shade, or a prism worn to fuse images. If all treatment fails, division of opposite muscle and re-adjustment of affected one may be performed (vide p. 79)

NYSTAGMUS [*Gr. νυσταγμος, a nodding?*]: *is marked by involuntary*, spasmodic oscilla-

it by inclining head in direct
that in which eyeballs oscilla
generally appears in infancy,
clear vision is difficult (on acc
opacities, refractive defects,
and impulse to proper inner
sened. Seen in coal miners
undue strain. *Treatment* ch
tic, as little can be done after
tablished. Whatever improv
to improve nystagmus.

MUSCULAR ASTHENOPIA ;
OF INTERNAL RECTI. Occu
high degrees of myopia, which
convergence and over-taxing
so occurs in general muscula
rarely, in hypermetropia. Ca
thenopia when fine work is at

inches. Prisms, base inward, to relieve strain upon interni. If these means fail, division of external recti to weaken their power. Advisability of operating on one or both of the externi depends on degree of insufficiency and on power of abduction.

EYELIDS.

The eyelids are subject to same affections as other parts of general integument—such as *hyperæmia*, *œdema*, *inflammation and abscess*, *erysipelas*, *acne*, *herpes*, *eczema*, *warts*, *nævi*, *syphilitic ulcers*, *cancer*, *&c.* These require same general treatment here as elsewhere. Special danger to be guarded against is that of inflammatory and cicatricial changes which easily produce deformity of lids with all its bad results.

BLEPHARITIS MARGINALIS OR CILIARIS [Gr. βλεφαρον, *eyelid*]; TINEA TARSI; OPHTHALMIA TARSI :—Essentially an inflammation of hair-follicles along edge of lid, but other structures soon become involved also. Edge of lid is at first hyperæmic; and later, swollen, smooth and glossy. Discharges form small, yellow scabs, which glue lashes together in little bundles. Little pustules appear about *roots* of lashes, which may leave *small ulcerations* and fissures. Hairs fall out.

also be everted.
grow altogether, leaving
[Gr. μαδαρος, *bald*]. Dise
other inflammations ; fr
ing influences ; in genera
ever cause ; and is most
and dirty classes. . Is o
some refractive anoma
when this is corrected.
recurrent. In *Treatment*,
importance. Crusts shou
several times a day with
line lotion (such as 10 grs.
cleansing, some astringent
Weak citrine ointment and
ointment are among the
nitrate of silver applied alo
are very useful. Refraction
carefully tested and correct

HORDEOLUM [Lat. *hor*
STYE: Is a boil affecting conn
edge of lid

il pus forms, when tumor should be firmly sped between thumb and finger, and ned by incision parallel to edge of lid. ieral health almost always requires atten-. Styes sometimes seem to be *aborted*, iey are touched, when first noticed, by ni-e of silver, or some astringent ointment lied. Sometimes it is useful to incise n when they first appear.

HALAZION [Gr. *χαλαζα*, *hail*]. TARSAL T :—Is occasioned by obstruction of ori- of sebaceous gland and retention of secre-. A tumor is thus formed in cartilage, erally about size of pea, and situated near junctival surface, so that it becomes promi-t when lid is everted. Overlying skin of ıral color and freely movable. If inflam-ion has occurred, cyst will contain pus; erwise it will be filled with gelatinous, fatty erial. Name applied also to chronic . *Treatment*—To evacuate cyst through junctiva or skin according to circum-ices. A free incision is made into tumor, if contents are purulent they readily es-e. If not, a curette is used to empty sac, its walls are cauterized or irritated so as bliterate it. Or, entire sac may be care- dissected out.

he lids are subject to several deformities duced by chronic inflammation, and by rs, burns, injuries, etc., which cause loss ssue and cicatricial contractions:

TRICHIASIS [Gr. *θριξ, hair*], is a
of the lashes so that they rub again

DISTICHIASIS [Gr. Διστιχια, *a do*
is same affection, except that there
be two rows of lashes. If inversion
long, cilia will be bleached by consta
ing in secretions, and may be easi
looked.

ENTROPION [Εντροπη, a *turning tow*
a turning in of free edge of lid against
It is sometimes spasmodic, from sp
orbicularis, especially in old people wi
skin.

ECTROPION [Gr. Εκτροπη, *a turning f*
is an eversion of lid, exposing its conjun
surface.

All above conditions keep eye in stat
constant irritation and discomfort. They
most commonly seen in the upper lid
variety of operations are performed for th
cure, a choice of which is determined
requirements of each case. In entropion te
porary relief is obtained by pulling out in
verted lashes by fine forceps (*epilation*), but
they soon grow again. Mild cases may be
relieved by removing an elliptical piece of the
skin of the upper lid and uniting edges of
wound by sutures. The shortening of the
skin thus produced tends to draw the edge
of the lid outward and away from the globe.
For bad cases the operation of Jaesche and
Arlt (Vienna, 19th cent.), or one of its modi-

fications, is very commonly performed. (See p. 249.) The operation of "*scalping*," sometimes done in inveterate cases, consists in dissecting off all the cilia with their bulbs, leaving the lids permanently bald. Many cases of ectropion result from injury and cicatricial contraction, requiring plastic operations.

PTOSIS [Gr. *πτωσις*, *falling*] is a drooping of upper lid, either partial or complete. Caused by injury of levator muscle; swelling, and increased weight of lid from inflammation; or by paralysis of 3d nerve (p. 150). Sometimes seen in old people from great relaxation of tissues. Rarely it is congenital.

PARALYSIS OF ORBICULARIS MUSCLE is a result of paralysis of *portio dura* of 7th nerve. Lids cannot be completely closed, and patient thus has a peculiar staring appearance called *lagophthalmos* [Gr. *λαγως*. *a hare*, and *οφϑαλμος*, *eye*]. The lower lid falls away from globe so that tears run over, and eye suffers from constant exposure to external irritants.

BLEPHAROSPASM: A spasmodic contraction of orbicularis, so that lids are firmly pressed together against globe. Occurs where photophobia is marked, and presents all grades of severity. It is reflex from irritation of 5th nerve and occurs in neuralgia of its branches; in inflammation of conjunctiva or cornea; from foreign bodies; in hyperæsthesia of retina, &c. *Treatment* consists primarily in removing cause. Other remedies are hypo

neuralgia of 5th,
sometimes practise

NICTITATION [La
A spasmodic contrac
by frequent twitchi
Seen generally in w

ECCHYMOSIS of lid
cellular tissue produc
undergoes discolorat
turning green, yello
sorption, cold appli
tions, and compress

INCISED AND
BURNS, etc., should b
especially if they in
formity of lids may r

EPICANTHUS [Gr.
angle of eye]: Con
which

PHORA [Gr. επι, *upon*, and φερω, *to bring?*]: WATERY EYE.—Is a condition common to nearly all lachrymal diseases. Caused by any impediment to efflux of tears through tear-passages, whether a simple displacement of puncta so that tears cannot enter them, or an obstruction in canaliculi, sac or ducts. Tears accumulate at inner angle of eye and flow over cheek, causing continual irritation and annoyance. Unless condition depends on some cause which can be otherwise removed, it must be remedied by operation. Method of opening canaliculi and probing nasal duct given at p. 79. Syphilis plays an important part in causation of lachrymal diseases, and should always be looked for.

DACRYO-CYSTITIS [Gr. Δακρυον, *tear*, κυστις, *bladder*]: ACUTE INFLAMMATION OF LACHRYMAL SAC:—ABSCESS OF SAC:—May result from conjunctivitis, nasal catarrh, exposure, injury, chronic disease of tear-passages, etc. Is attended by great pain, tenderness, redness and puffy swelling over sac and extending to lids. If disease progresses, skin becomes thinned and abscess bursts through it. *Treatment.*—Opening of canaliculus so as to give free exit for pus and prevent perforation through skin. If latter is imminent, free incision should be made through skin into sac, and kept *open* until abscess is completely *drained. If* perforation has already occurred

CHRONIC IN
ORRHŒA OF SA
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inflammation of
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associated with
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of canaliculi with
other point. Th
irritability of eye.
if it is pressed up
through puncta.
ing canaliculi and
ages by probing or
injected into sac so
ment moderately su
very protracted, and
For extremely troub
of bones, an opera
sometimes performe
FISTU

gland, *dacryo-adenitis*, usually chronic : *cysts of gland*, *dacryops* [Gr. δακρυον, *tear*, and ωψ, *eye*], usually due to closure of excretory ducts and distention from secretion above : *fistula of gland*, generally resulting from abscess, dacryops or injury ; and *cancer*. Extirpation of gland is sometimes performed.

ANOMALIES OF REFRACTION AND ACCOMMODATION.

The *refraction* of an eye is its faculty of bringing paralell rays of light to a focus upon its retina without any effort of accommodation, and depends on the form of the globe and its refractive media.

The *accommodation* of an eye is its power of adjusting itself for vision at different distances—that is, for rays of different degrees of divergence. Nature of accommodation and method of measuring it given at p. 46.

EMMETROPIA. E. [Gr. εν, *within*, μετρον, *measure*, and ωψ, eye]:—that state of refraction in which parallel rays are brought to a focus upon retina when eye is at rest.

HYPOMETROPIA or BRACHYMETROPIA [Gr. ὑπο, *under*, or βραχυς, *short*, μετρον, *measure*, ωψ, *eye*]: that state of refraction in which, with eye at rest, parallel rays are focussed *in front* of retina, only divergent rays being united upon latter. Usual name for this condition is

HYPERMETROPIA [G
measure, *ωψ*, *eye*]: th
which, with eye at r
focussed *behind* retina
being united upon latt

ASTIGMATISM [Gr. *a*,
a point]: that state c
with eye at rest, rays f
united in a point. (Se

AMETROPIA [Gr. *a*,
sure, *ωψ*, *eye*]: name
conditions which devia

ASTHENOPIA [Gr. *a*
eye], or WEAK SIGHT ;
symptoms often seen i
defects. After readin
length of time, letters
run into one another,
hot, painful or fatigu

generally of low degree and causes little annoyance; high grades apt to be progressive, and, if so, are associated with marked irritation and asthenopia. Far-point of distinct vision lies nearer eye than it should. Beyond this point, all objects appear indistinct. Far-point expresses degree of the M; for instance, if patient cannot see clearly beyond 24 inches he is said to have M $\frac{1}{24}$. To see distant objects, the rays, before entering his eye, must be made to diverge as if they came from a point 24 inches away, as thus only can they be united on his retina. This is done by concave glass of 24 inches focus. With ophthalmoscope, details of fundus of a highly myopic eye can be seen by direct method at some distance away; and if head is moved to one side objects of fundus are seen to move in contrary direction. This is due to fact that, in such cases, an aerial image of fundus is formed by refractive media of eye itself at distance corresponding to M. For example, in M $\frac{1}{3}$, at 3 inches in front of eye. To get clear view of fundus in erect image, a certain concave glass must be used behind mirror. Focal length of this glass, *plus* its distance from nodal point of observed eye, equals the M. By indirect method, disc and vessels appear smaller than in E. Posterior staphyloma is often seen around disc, and is called *myopic arc* or *crescent* (p. 121). (See p. 250.)

Treatment. General directions are to avoid

by concave glasses whic
divergent enough to be
is the rule to give th
which best vision is obt
frequently amblyopic al

HYPERMETROPIA. H.
erally by optic axis being
ally by refractive power
be congenital and hered
senile changes in eye and
not see distant objects c
convex glass, or (what a
a certain amount of acc
the object, greater the s
dation. This leads to
muscle and asthenopia,
at fine work. May a
(p. 146).

Manifest H: is that
out paralysing accomm

Latent H: that whi

Relative H: far and near objects are clearly seen, but only by converging visual lines to point nearer than object—by giving eyes periodic squint.

Absolute H: neither near nor distant objects can be seen clearly without convex glasses.

The strongest convex glass through which patient obtains his maximum acuteness of vision for distant objects represents his manifest H. If accommodation is paralysed by atropine, the strongest convex glass which gives greatest acuteness of vision represents total H, including latent, if any existed. With ophthalmoscope, details of fundus may be seen by direct method some distance away, and if head is moved to one side they are seen to move in same direction. On going closer, a certain convex glass will be needed behind mirror to get a clear erect image: and focal length of the glass, *minus* its distance from nodal point of observed eye, equals exact degree of H. Field of vision larger and image smaller than in E. By indirect method, disc and vessels look larger than in E. See p. 250.)

Treatment consists in correcting refraction by suitable convex glasses. In manifest H. we may give for distance the strongest glass which gives the patient his most distinct vision. In latent H. no fixed rules can be given. It is usually necessary to begin with a weak glass and advance gradually.

ly congenital, and may
quired, by inflammation
of corneal incision afte
improper glasses, &c.
and least curvature are
pal meridians. Astig
ferent focal lengths of
called *regular*. That c
refraction in same me
lar. Latter form con
in structure of lens or
(*normal irregular ast*
through disease (*abno*
matism): chief subjec
cular polyopia (eye see
age), and metamorph
toms are irregular c
changes of curvature
oblique illumination, c
objects of fundus, w
astigmatism cannot b

hypermetropic. Astigmatism is corrected by means of cylindrical glasses (p. 50). (All eyes are naturally astigmatic, the curvature being slightly stronger in vertical than in horizontal meridian. No inconvenience is usually felt unless As. is $\frac{1}{40}$ or more.

PRESBYOPIA. Pr. [Gr. πρεσβυς, *an old man*, ωψ, *eye*] : FAR SIGHT : Name applied to condition of diminished range of accommodation seen in elderly people. Consists in a recession of the near point due to changes in ciliary muscle and lens, so that accommodative act can no longer render latter as convex as before. First symptom is that small objects cannot be seen clearly at so short a distance as formerly, but must be held further away from eye, especially in evening. Distant vision, however, remains unimpaired. Recession of near-point begins in all eyes in youth and gradually progresses during life. Does not usually cause inconvenience until after 40. Appears earlier in hypermetropic eyes. *Presbyopia* is assumed to begin when near-point has receded beyond 8 inches. Degree of Pr. is found by deducting patient's near-point from this. Thus, if *p* lies at 16 inches, $\text{Pr.} = \frac{1}{8} - \frac{1}{16} = \frac{1}{16}$. Pr. is easily corrected by convex glasses for reading, and they should be given as soon as the affection appears. Usual to give weakest glass which renders work comfortable at proper distance.

matter of experim
which differ by m
borne. Condition i

APHAKIA [Gr. α
lens]; ABSENCE
May be congenital
of lens after injury,
dislocation. Refra
very much lessened
rule, entirely absent
occurred where so
mained in lensless e
glasses required for c
weaker ones for dist
natural corneal asti
rent.

PARALYSIS OF A

still able to see clearly at their far-point, which may be only a few inches from the eye, *e.g.*, in M$\frac{1}{12}$. Convex glasses restore the vision for near objects at once. Diagnosis is easily made if range of accommodation is tested. *Treatment* consists primarily in removing any apparent cause—such as general debility. Iodide of potash sometimes useful. Some myotic, locally, may be beneficial.

SPASM OF CILIARY MUSCLE (*apparent myopia*): Sometimes occurs in ametropia, especially in H., and also in emmetropia following upon undue straining of accommodation. Causes asthenopia and dimness of vision for distant objects. Latter is perfectly relieved by weak concave glasses. The true state of refraction may be found by the ophthalmoscope; or, if there is doubt, atropine may be used. *Treatment:* strong sol. atropine until spasm is completely overcome.

SIMULATED BLINDNESS: Often met, and sometimes very difficult to detect. Simulated blindness of one eye may be detected by holding a prism before healthy eye, when, if patient sees two images, simulation is proved. If eye is truly blind, pupil should be partly dilated and insensible to light when healthy

which are so arrang
position when seen
Thus, if patient is si
right eye, he will n
only the left-hand
scope ; but this reall
and so the fraud is
with test-types and
patient's statements
ful. When atropin
for deception, pupil
ad maximum, and
other eye. In absol
pupils should not
light.

PHOTOPSIA [Gr.
sight] ; PHOSPHEN
sparks, luminous ri
describe as seen be
cur in retinal inflam
eye, etc. Also oc

COLOR-BLINDNESS; DALTONISM. [After chemist Dalton, who first described it.] Is an inability to distinguish colors, and is of variable degree. Congenital, or result of disease, especially of atrophy of optic nerve. May also be produced by long-continued strain of eyes in working at colors. If only two of the three primary colors can be seen, condition is called *dichromic vision*. Where no color can be distinguished, condition is called *achromatic vision*. Is more frequent in males than in females. Red-blindness is most frequent form. (See p. 53.)

Herpes zoster ophthalmicus, or *ophthalmic herpes*, affects the skin supplied by the ophthalmic division of the 5th or trigeminal nerve,—that is, the forehead, upper lid, and side of nose. It never crosses the median line. The eruption of herpetic vesicles is generally attended with pain. There may be corneal ulceration and iritis, with photophobia and lachrymation. Most frequent in old people. Cold a common exciting cause. Disease obstinate. May leave deep scars, severe neuralgias, and anæsthesia of skin and of cornea. Treatment not very satisfactory. Comprises atropine, evaporating lotions, tonics, etc.

PART II.

OTIC MEMORANDA

CHAPTER I.

IY AND PHYSIOLOGY OF THE EAR.

auditory apparatus consists of a com-
l structure (*the ear*) for collecting
s impressions, and conveying them to
itory nerve, which transmits them to
in. Delicate parts of the ear are
y imbedded in the petrous portion of
nporal bone. The sound-waves are
d by the auricle, conveyed through
auditory canal, and received upon the
ana tympani, which is thrown into cor-
ding vibrations. These vibrations are
ed by the chain of bones through the
num to the fluid of the labyrinth, and
the terminal auditory nerves. The im-
ons there received are transmitted to the
here they are perceived as *sound*.
ana tympani is so arranged as to
iations of tension in accordance
rent kinds of waves which strike
sure of the air in the tympanic
y its communications with
h the pharynx through
he component parts

semicircular canals have
governing the equilibrium
having little or no part in
[Buck suggests that they
valves to protect the termi
injury in cases of very lou
where the stapes is drive
the fenestra ovalis.] Ou
physiology of audition is
several points.

THE ANATOMY OF THE
veniently divided, for the s
as follows :—

I. **EXTERNAL EAR.** { (a) *Auricle.*
(b) *Externa*

II. **MIDDLE EAR.** { (a) *Membra*
(b) *Cavity*

pendage fastened to malar and temporal bones by elastic fibres. Has fibro-cartilaginous framework closely covered by perichondrium and skin. Latter forms projection from lower end of cartilage called *lobe* of ear. Outer edge of auricle called *helix* [Gr. ἑλίσσω, *to twist*]. Within helix is *fossa navicularis* [Lat. *navicula, small boat*]. At inner edge of this is another ridge, *the anti-helix*. In front of opening of auditory canal is projection called *the tragus* [Gr. τραγος, *goat:* because hairs like goat's beard usually grow here ?] Opposite this on other side of canal is similar projection, *the anti-tragus*. Concavity around orifice of canal called *the concha*. [Gr. κόγχη, *concave shell.*] Above this is triangular depression, *the fossa triangularis*. Skin of auricle covered by downy hairs, and contains sebaceous glands (largest in concha), and sweat-glands (chiefly on side next skull).

Muscles of Auricle.

Levator or *attolens aurem :* O. aponeurosis occipito-frontalis. Fan shape. Fibres converge to I. at upper part of auricle. Lifts auricle. Supplied by small occipital nerve.

Attrahens aurem : O. lateral edge aponeurosis occipito-frontalis. I. in front of helix. Draws auricle forward and upward. Supplied by facial and auriculo-temporal branch of inf. maxillary nerve.

ervical plexus,
uricular from
neumogastric.
inf. maxillary

atus audito-
uns from auri-
forward and
al curve hav-
anal is higher
Average length
owest parts at
and close to
cartilaginous,
cle, and inter-
ntorini, filled
ny, part of tem-
alls developed
growth of skull ;
anic ring or *an-*
] of fœtus,—an
wanting, which
ually joins with
ony canal exists,
rane, which dis-
d.] At bottom
us, is tympanic
Lat. equiv.] for
ani. Groove and
gment of irreg-

ial surfac
ward. Supplied by p
facial.
[Above muscles rudim
Intrinsic muscles :
Slightly developed ;
Tragicus : lies on
cartilage auditory ca
Anti-tragicus : li
wall of cartilage aud
Helicis major : ru
and passes into leva
Helicis minor : l
between its root an
Transversus aur
face auricle from
across furrow corre
Obliquus auric
auricle over furro
root anti-helix.
Dilator of conc

Nerves of Auricle.

uriculus magnus, from cervical plexus,
ost. surface auricle. *Post. auricular* from
l. *Auricular branch* from pneumogastric.
iculo-temporal branch from inf. maxillary

xternal auditory canal. Meatus audito-
externus [Lat. *equiv.*]:—Runs from auri-
to membrana tympani, forward and
rd, crooked course, principal curve hav-
onvexity upward, so that canal is higher
iddle than at either end. Average length
t 1 in. Width varies; widest parts at
ion of bone and cartilage, and close to
brana tympani. Outer ⅓ cartilaginous,
nuous with cartilage of auricle, and inter-
ed by fissures, *incisuræ Santorini*, filled
fibrous tissue. Inner ⅔ bony, part of tem-
l bone. [Sup. and post. walls developed
temporal bone in general growth of skull;
and inf. walls from tympanic ring or *an-*
s tympanicus [*Lat. equiv.*] of fœtus,—an
bony ring, with upper ¼ wanting, which
lependent at first but finally joins with
of bone. At birth, no bony canal exists,
ing represented by membrane, which dis-
ars as bone grows outward.] At bottom
nal, in annulus tympanicus, is tympanic
re *sulcus tympanicus*, [*Lat. equiv.*] for
tion of membrana tympani. Groove and
interrupted above by a segment of irreg-

ular outline, about $\frac{1}{10}$ in. high
the *segment of Rivinus* [Rivinus
cent.] Each end of segment m
jecting bony spine. Helmholtz
cent.] calls ant. point *spina tym*
(*spina tymp. posterior* of Henle)
spina tympanica minor. Owi
position of membrana tympani,
walls of canal are longest. (p. 18
by integument containing soft
ceous and ceruminous glands.
sweat-glands. *Cerumen* [Lat. for
chiefly of fat and coloring matter
becomes thinner as it approach
tympani. Canal in relation in fr
ulation lower jaw; in front an
parotid gland: behind with mas
transverse sinus: above with r
dura mater, and middle fossa of

Vessels:—Post. auricular arte
ricular from int. maxillary, enter
lation lower jaw. Largest ve
upper and post. walls.

Nerves from 3d branch 5th an
mogastric, entering through ant.

MIDDLE EAR.

Membrana tympani or Drum
at bottom of ext. auditory canal

from tympanic cavity. Placed obliquely, forming acute angle (45°) with inf. and ant. walls of canal and obtuse one with sup. and post. walls. Upper border about $\frac{1}{4}$ in. nearer to entrance of canal than lower; post. border about $\frac{1}{8}$ in. nearer than ant. [In infant lies more horizontally and nearly in line with upper wall of canal.] Of ellipsoidal shape with long axis (about $\frac{1}{3}$ in.) downward and forward. At upper part presents conical protrusion,—apex corresponding to short process of malleus, and base spreading out in front and behind, forming *anterior* and *posterior folds*, anterior being the shorter one. General position of membrane is arched, with concavity outward. Deepest concavity surrounds end of malleus-handle and is called *the umbo* [Lat. for *boss*, of a shield.]. Membrane inelastic, about $\frac{1}{250}$ in. thick, and composed of 3 layers :—a middle fibrous layer, covered externally by skin of auditory canal, and internally by mucous memb. of tympanum. Dermoid layer very thin and devoid of hairs and glands. Middle layer, *lamina propria* presents two layers of fine fibres, an outer *radiating* and an inner *circular*. In ant. half of memb. outer fibres radiate from tip of malleus as centre; in post. half they radiate from entire length of malleus-handle. In centre of memb. circular fibres form very thin layer which grows thicker towards periphery and there becomes thin again or disappears. Between

cular fibres (p.
memb. is fibrous
broad, running fr
bony ring (p. 1
forming a pocket
the posterior pou
in front of malleus
by spina tympanic
cess malleus, muc
malleus, chorda ty
panic artery. At
layers unite to for
inserted into sulc
Tendinous bands
segment to short pr
these is triangular
segment, and filled
layers, more flaccid

ficial temporal of 5th. In inner, from tympanic plexus and nerves of cutis.

Lymph vessels found in all layers.

Seen through the auditory canal, the normal memb. tympani presents a delicate, bluish-gray color and is quite translucent. Short process of malleus appears as a whitish tubercle at upper border, and handle of malleus as a whitish stripe running from this down and back towards the centre of the memb., dividing it into ant. and post. parts, of which the former is the larger. *The "light-spot"* is a bright, triangular reflection with its apex towards the tip of the malleus-handle and base ($\frac{1}{25}$–$\frac{1}{18}$ in. broad) towards the periphery of the memb. It results from the oblique position of the memb. and from its marked concavity at this point. Sometimes one or two fine vessels may be seen, especially along the malleus-handle.

Cavity of tympanum or *drum of the ear.* [Lat. *tympanum*, *drum*] :—Irregular, air-containing space lying behind drum-head. Lined by mucous membrane continuous with that of Eustachian tube and pharynx. Average diameters; antero-posterior $\frac{1}{2}$ in.; anterior vertical $\frac{1}{8}$–$\frac{1}{3}$ in.; post. vertical $\frac{3}{5}$ in.; anterior transverse $\frac{1}{8}$–$\frac{1}{6}$ in.; transverse opposite drumhead $\frac{1}{12}$ in. Folds of mucous memb. stretch from one bony point to another, in some places

from it by thin plate
which ends by small proj
processus cochleaformis
ates tympanum from
sents openings into cel
under roof. *Outer wal*
drumhead, but extends
upward than this; has
chordæ posterius, [Lat
with centre of drumhea
edge, the opening of a
scends in front of Fallo
joins it. Chorda tympani
up under long process
post. pouch, then forw
leus, and leaves tympa
anterius, or *canal* of *H*
front of memb. tympan
with (3) *Glaserian fiss*

tunda [Lat. for *round window*], $\frac{1}{12}$ in. diameter, leading into cochlea. Closed by membrane called *membrana tympani secundaria.* In front of fenestræ and extending between them is a rounded projection, *the promontory*, corresponding to first whorl of cochlea. Presents grooves for nerve-twigs. In front of promontory, wall very thin and covers carotid artery. Above and behind fenestra ovalis is a ridge corresponding to *Fallopian canal* which contains facial nerve. Behind and below fenestra ovalis is *the pyramid*, or *eminentia Stapedii*, a conical eminence containing circular canal which encloses stapedius muscle and communicates below with Fallopian canal. On level with fenestra ovalis and behind ridge of Fallopian canal is a smooth surface corresponding to horizontal, semicircular canal. *Upper wall* very thin (sometimes wanting) and separates tympanum from cranial cavity. *Lower wall*, sometimes very thin or wanting, separates tympanum from jugular vein. Pierced by glosso-pharyngeal nerve.

The Ossicles of the Ear, or *Ossicula auditus* [*Lat. equiv.*]: are three small bones—*malleus* [Lat. for *hammer*], *incus* [anvil], and *stapes* [stirrup], which form a chain across tympanum. Covered by very thin periosteum and mucous memb. *Malleus* presents head, neck, short process, handle or *manubrium* [Lat. for

handle],and long process,proces
Folianus. Handle and short pro
to middle layer of drumhead (p.
ment firm at end of handle, loose
process, leaving sort of joint-
Long process runs forward and
wardGlaserian fissure; 3½ lines lo
dwindled to a short stump in ac
and neck of malleus attached by
fibres. Those running from spin
major to neck of hammer and env
process up to Glaserian fissure,
mentum anterius mallei. Tho
from neck of malleus to border
segment, *ligamentum mallei exter*
running from head of malleus to
panum, *ligamentum mallei supe*
posterior group of fibres of ligame
num called *ligamentum posticu*
with middle group of ligamentun
called *axis-band* of hammer. (
Head articulates with incus by p
containing *cog*, which allows mall
outward, but prevents it from rot
without carrying incus with it.
sents head, long and short pro
articulates with malleus. Joined
roof by *ligamentum incudis supe*
process runs back and articulate
wall tympanum. Long proces
parallel with and behind handle
and ends in lens-shaped tip, whi

with head of stapes. Joint is flat segment of sphere, convex toward stirrup. *Stapes* presents head, neck, crura, and base. Head articulates with incus. Base is surrounded by lip of fibro-cartilage and rests in fenestra ovalis; union between it and wall of vestibule is by periosteum of latter extended over base. A thin membrane inserted into side of base and inner edges of crura, closing opening between them, is called *ligamentum obturatorium stapedium*. Joints of ossicles provided with articular cartilages and capsules. *Tensor tympani muscle* arises from periosteum of upper wall of canal in which it lies, from upper wall of cartilage of Eustachian tube, and from neighboring border of sphenoid. Before leaving canal it becomes tendinous, and tendon turns around processus cochleaformis (p. 184) at nearly right angle, to be inserted into ant. half of inner side of hammer at beginning of handle and a little below short process. Supplied by nerve from otic ganglion. Draws handle of hammer inward and renders memb. tympani tense, and all the ligaments of the ossicles (except superius mallei) are simultaneously put on the stretch; at the same time the long process of the incus is made to rotate inward with the malleus handle, and so to press the stirrup against the oval window and fluid of the labyrinth. *Stapedius muscle* arises from cavity in *pyramid* in which it lies. Tendon leaves canal at obtuse angle

Arteries of tympanic
branch int. maxillary, e
fissure. Stylo-mastoid
entering by stylo-mastoi
branch middle meninge
Fallopii. Branches from
and int. carotid enteri
Eustachian tube.

Veins empty into mid.
ryngeal.

Nerves: To muscles,
memb. from *tympanic pl*
from tympanic branch
of petrous ganglion gl
tering by small foramen
from branch of superfici
from above; and from
plexus of sympathetic en

branches to tensor tympani and tensor palati muscles. *Chorda tympani nerve* passes across tympanum (between handle of malleus and long process of incus and along lower margin of post. pouch of memb. tympani), but seems to have no physiological relation to it.

The mastoid cells consist of a large number of irregular cells, of varying size, contained in mastoid process of temporal bone. Whole are surrounded by dense cortical layer of bone $\frac{1}{25}$—$\frac{1}{12}$ in. thick. In upper part of process there is a single large cell, *the mastoid antrum* [Lat. *antrum*, *cave*], which communicates with lower cells, and from which one or more openings lead into tympanum through its anterior wall. Cells are lined by thin mucous membrane. [At birth mastoid process is rudimentary, and contains only one large cell, which corresponds to antrum.] *Vessels* of cells from stylo-mastoid branch of post. auricular. *Nerves* from tympanic plexus.

The Eustachian Tube [Eustachius, Venice, 16th cent.] :—Leads from pharynx upward, outward and backward to tympanum, at angle 135° with axis of ext. auditory canal. Consists of cartilaginous and bony portion, whole length being about $1\frac{3}{8}$ in. Tympanic end is bony ; triangular shape ; about $\frac{1}{2}$ in. long and $\frac{1}{12}$ in. diameter. Outer wall belongs to *pars tympanica,* median wall separates tube from *carotid canal,* and upper wall, *septum tubæ*,

gular one, which is
whose upper and out
smaller, hook-shaped
tached to base of skull.
part of tube (equal to
ference) is formed of
part of tube is at *isthm*
tilaginous and bony pa
is trumpet-shaped, ab
and lies in post. nas
floor of nostril. Inne
into pharynx so that m
in a frontal plane. T
memb., which in bo
closely to periosteum
acinous glands, which
panic end. Memb. q
end. Epithelium cil

calibre of tube. Fibres said to pass into those of tensor tympani. Supplied by internal pterygoid nerve.

Levator veli palati: O. lower surface of temporal bone on ant. border of entrance to carotid canal, and from cartilage of tube. I. in region of osseous tube on bone, cartilage and mucous memb. of tube. Presses membranous floor of tube forward, enlarging transverse diameter. Supplied by pneumogastric nerve.

Salpingo-pharyngeus: Thin muscular layer connected to lower end of median cartilage, to mucous memb. and post. wall of pharynx. Considered as fixator of median cartilaginous plate. Called fascia by some.

Vessels of tube: Ascending pharyngeal from ext. carotid. Middle meningeal from int. maxillary. Branch from int. carotid.

Nerves of tube:—Branches to muscles *q. vide.* Sup. pharyngeal from 5th. Glosso-pharyngeal.

Whether tubes are normally open or closed is disputed. They are opened during act of swallowing. A semi cylindrical space under hook of cartilage is called *safety-tube,* and supposed to be always open.

INTERNAL EAR, OR LABYRINTH.

Is the essential part of the hearing apparatus, containing the ultimate filaments of the

auditory nerves. Comprises s
cavities contained in the petrou
which are corresponding mem
receiving the distribution of the
and intervening spaces are fille
fluid.

BONY CAVITIES are: (1)
Semicircular canals. (3) *Coch*

VESTIBULE:—Irregular ovoi
ameters from above downward
hind forward about $\frac{1}{5}$ in., and
inward about $\frac{1}{10}$ in. *Outer or*
contains *foramen ovalis* (p. 184);
anterior opening of horizontal
canal. On *inner wall*, near upp
are two depressions, *recessus*
recessus sphæricus; small ridg
them called *crista vestibuli;* cris
into pyramidal elevation, *pyran*
below, it divides into two branch
close a space called *recessus co*
cessus ellipticus is partly bounde
shallow furrow, *sinus sulciformis*
recessus, ampullar orifice of ant.
circular canal opens; at post.
wall is opening of *aquaēductus ve*
canal running into vestibule from
of petrous bone; contains tubul
tion of lining memb. of vestibu
the cranium between the layers
mater. At junction of inner ar
is opening common to both

circular canals. At same level in middle of post. wall is post. opening of horizontal semicircular canal. In angle of post. lower and inner walls is lower opening of post. vertical semicircular canal. On ant. apex of vestibule below recessus sphæricus, and below ant. edge of fenestra ovalis, the scala vestibuli of the cochlea begins (p. 196). *Maculæ cribrosæ* [Lat. *macula, spot*, and *cribrum, a sieve*], for entrance of twigs of auditory nerve are on inner wall, but are only visible by microscope in adult. Each macula consists of a group of fine holes. The largest one, *macula cribrosa superior*, lies at upper end of crista vestibuli, and admits nerves to utricle and to ampullæ of ant. vertical and horizontal semicircular canals. *Macula media* lies in recessus sphæricus, and admits nerves to saccule. *Macula inferior* lies at ampullar opening of post. vertical semicircular canal, and admits nerves to ampulla. A fourth macula lies in upper part of recessus cochlearis, and admits twig of cochlear nerve to septum between utricle and saccule.

SEMICIRCULAR CANALS: are C-shaped, starting from vestibule and returning to it again. Horizontal one convex laterally. Other two are vertical (anterior and posterior) at right angles to each other. Five openings in all, one being common to both vertical canals; for situation in vestibule *vide* p. 180. Openings called *ampullæ*, from flask-shape.

[Lat. *ampulla*, *flask.*] Dime
Length of ant. vertical $\frac{4}{5}$ in. Of
about $\frac{11}{12}$ in. Of horizontal abo
common to both vertical canals,
munis, about $\frac{1}{12}$–$\frac{1}{8}$ in. long. Ave
of canals $\frac{1}{20}$–$\frac{1}{15}$ in. Openings o
canal close together, at about
those of post. vertical stand or
other ; those of horizontal close to
vertical.

COCHLEA:—So called from re
snail [Lat. *cochlea*, *snail.*]. Is
coils around a central pillar or ax
toward one extremity, where it e
de-sac. About 1½ long, $\frac{1}{10}$ in. di
ginning and $\frac{1}{20}$ in. at end. Ma
from below upwards, from left to
ear, and *vice versa* in left. Ape
directed forwards and outwards,
roof. Cochlea is separated in fr
wall from carotid canal. Inwar
upon blind end of internal auditor
croaches as *promontory* on inner
panum. *Axis*, *spindle*, or *mo*
modiolus, *hub of a wheel*,] is comp
walls of tube and of central spon
stance circumscribed by its turns.
from base to apex, being about
ter at former and $\frac{1}{30}$ in. at lat
about $\frac{1}{6}$ in. Base rests upon b
ternal auditory meatus. Apex
wall of last half whorl, ending i

: section of a funnel, called *infundibu-*
Lat. for *funnel*]. Spongy substance is
rated by numberless small canals which
ıtwards from base to spiral lamina, and
passage of nerves and vessels from
s auditorius internus. Two of the canals
ıg in spongy substance have names.
walls are perforated by fine holes
ponding to canals running to spiral
a. One, *canalis centralis modioli*,
s in fossa cochlearis and runs in axis
diolus from base to apex. The other,
s spiralis modioli, or *canalis ganglion-*
uns spirally along outer wall of modiolus
e of junction of lamina spiralis: oval
separated from scala tympani by thin,
form lamella, and ends at apex near
lus. Canals transmit vessels and nerves.
ıalis spiralis lie ganglia of cochlear nerve.
uter surface of modiolus, and running
ly around its axis from base to apex, is
ecting bony ledge called *lamina spiralis*
Made up of two lamellæ which at its
where they come off from wall of modi-
enclose spongy bone-substance, commu-
ng with canalis spiralis modioli. Its
dge, where lamellæ approach each other,
nner. Post. lamella forms outer wall of
s spiralis; anterior passes into wall of
vestibuli. Lamina diminishes in width
ickness towards apex. In first whorl,
ts into tube of cochlea $\frac{1}{20}$ in., in last

cupola. The
spiralis membranacea st
of bony lamina across to
canal. A complete par
dividing canal into tw
[Lat. for *stairways*]. L
turned towards tympa
memb. tympani secunda
tympani. Upper one a
bule(by recessus sphæric
vestibuli. At apex of
open into each othe
arachnoidal cavity o
tion called *helicotre*
twist, and τρημα,
doubted by Buck.]
by one end into lab
on surface of petrous

downwards, inwards and forwards in inner wall of jugular fossa, and opens at bottom of triangular depression towards middle of edge, which limits inner and inf. surface of petrous bone. Transmits vein carrying blood from cochlea and empyting into jugular.

The *periosteum* of the labyrinth is, excepting that of outer wall of cochlear canal, very delicate. Consists of several layers of very fine fibrous network, compared by Henle to memb. suprachoroidea. In spaces of network are smooth round or elliptical nuclei, sometimes like epithelium. Also stellate pigment-cells and minute round or ovoid calcareous deposits. Rich supply of vessels. From periosteum of vestibule and semicircular canals fine fibres and many blood-vessels run to outer surface of corresponding parts of membranous labyrinth.

THE MEMBRANOUS LABYRINTH.

The *utricle* [Lat. *utriculus, a little leathern bottle*] :—is a flattened elliptical tube placed upon inner wall of vestibule. Long diameter, ⅛ in., corresponds to height of vestibule, upper end lying on pyramid, lower end lying opposite ampullar opening of post. vertical semicircular canal. Fastened to recessus ellipticus by fine vascular, nervous and connective-tissue network. Outer wall free and separated from outer wall of vestibule by space filled with *endolymph*.

but in other parts
between the two, which i
tissue, vessels and fluid.
of utricle are clear, trans
cate ; about $\frac{1}{1250}$ in. thic
(1) an outermost layer (*m*
culate and nuclear fibro
bloodvessels ; (2) a basal
an innermost layer of p
On inner surface of walls
side next to bone, mem
numerous elevations. O
and saccule is a more de
shape, $\frac{1}{12}$ in. diameter,
where twig of auditor
There is a still more
acustica, embracing abo
ampulla, near its utricul
color about [illegible] by [illegible] in

her by mucoid substance. Powder con- of crystals of carbonate of lime, of vary- rm and size. Largest about $\frac{1}{2000}$ in. long $\frac{1}{3000}$ in. broad. How otolith is held to of utricle is not settled.

e saccule is a flask-shaped sac, whose (about $\frac{1}{16}$ in. diameter) lies in recessus ricus, its blind base directed upward and rd against utricle, the walls of the two sacs united at a single point. Neck of sac, *lis reuniens* (about $\frac{1}{35}$ in. long and $\frac{1}{120}$ in. eter), runs from lower wall down and , and sinks into upper wall of vestibular of ductus cochlearis at nearly a right , so that a blind sac is formed at junc- f the two parts.

e ductus cochlearis begins with above sac in vestibule, and passes through cochlea to apex, where it ends in another sac. Lower end rests in recessus coch- , upper end in cupola. Ductus attached e side to lamina spiralis ossea; on other, ter wall of bony cochlear canal. On -section is triangular, two walls diverging edges of lamina spiralis, and third, cor- nding to part of cochlear wall, comprised een insertions of the other two. Lower turned toward scala tympani, called *tym- l;* upper, towards scala vestibuli, called *ular*. On border of lamina spiralis ossea oft structure—*limbus laminæ spiralis*— *lengthens* lamina toward ductus, and is

developed from periosteum of
tibular wall of ductus passes c
surface of lamina ossea at inn
of limbus, so that latter is inclu
Limbus has two lips, an upper, *l*
lare, and a lower, *labium tympa*
between them called ***sulcus spi***
Upper lip projects like a roof ov
its edge is divided by furrows in
tions, which on front view rese
surface of incisor teeth, and are
tory teeth. Furrows filled
(epithelial?) cells, continuous wi
ing memb. vestibularis. Tymp
floor of sulcus and has two laye
in sharp border, continuous
basilaris. *Membrana vestibularis*
membrane, forming vestibular v
runs from edge of lamina spir
outer wall of cochlea. Consists
connective-tissue basis, cover
thelium on vestibular side and
on tympanic side. *Membrana*
βασις, *base*], forming tympanic w
is continuation of labium tym
increases in width from base
cochlea, as lamina spiralis decre
into two zones, an inner, *haben*
habenula, a little thong, and *tego*,
an outer, *zona pectinata* [La
comb-like]. Essential layer is
membrane. This is thickest

and is there covered, on tympanal surface, with knobby elevations. Embedded in basis substance is a small vein, *vas spirale*, anastomosing through radial branches with vessels of lamina spiralis ossea. On vestibular surface is a layer of very fine radiating fibres, which are most prominent in zona pectinata. Sometimes, fine spiral fibres are found on tympanal surface. Corti's organ lies on inner zone. Outer wall of ductus presents internally the memb. propria of the ductus; externally. the periosteum; and, between, a semilunar cushion of connective tissue. Points of insertion of memb. vestibularis and memb. basilaris are prominent, the former called *angulus vestibularis*, the latter, *ligamentum spirale*. A part of the memb. propria just above ligamentum spirale is very vascular and called *stria vascularis*. At lower limit of stria is an elevation, *ligamentum spirale accessorium*, containing a vessel, *vas prominens*. Space between this and insertion of memb. basilaris is called *sulcus spiralis externus*.

Cavity of ductus cochlearis is divided into two parts by a membrane, *Corti's membrane* or *membrana tectoria*, [Lat. *tectorius*, *covering*,] which runs parallel to memb. basilaris from labium vestibulare to outer wall of cochlea. Latter insertion is about midway between memb. basilaris and stria vascularis. Upper space is filled with endolymph. Lower contains terminal auditory apparatus. Tectorian

of several fine layers
one consists of a ver
Henle thinks mem
so that it cannot
beneath. According
ends near outer wall
rests directly on Cor

Terminal auditory
prises the structures
the ductus cochlearis.
lars or teeth of Corti
are arranged in regu
the keys of a piano.
with slender cylindr
ends, containing gra
rows, an *inner* (that
and an *outer*. Rods
end, or *pedestal*, on

nerve bundles. Tissue of rods is hard as cartilage (Henle). To heads of rods are fastened plate-like processes—the *head-plates*. Inner rods have two—one on inner and one on outer surface—enclosing a smooth concavity between them, in which heads of outer rods rest, one of latter articulating with two or more of former. Plate on head of each outer rod projects from outer surface, like a phalanx, beyond the joint. Estimated number of pillars: inner, 6,000, outer, 4,500. A perforated membrane, *the lamina reticularis* [Lat. *rete, a net*] arises from articulation of rods, and stretches, parallel to memb. basilaris, to outer wall of cochlea. Formed of network of fine hyaline threads, with oblong and round meshes arranged in rows. Tissue, though delicate, is quite firm.

The cells found in ductus cochlearis—*auditory cells*—are nucleated, round, and cylindrical. A layer of them covers sulcus spiralis, Reissner's memb., and outer wall of ductus. Upon inner pillars lies a single row of conical cells with large nuclei. They send processes into row of small cells lying next them toward sulcus—the *granular layer*. The ends turned toward heads of rods bear tufts of stiff, immovable cilia. These cells called *inner hair-cells* (*inner roof-cells* of Henle). Number computed at 3,300. On outer rods lie 3 or 4 rows of double nucleated cells connected by slender processes to memb. basilaris and memb.

of openings in th
describes anothe
the memb. basilar
cells. He conside
ganglionic. Wald
also the rods of Co

Auditory nerve
soft part] of 7th n
medulla oblongata.
of origin is in floor o
is in crus cerebelli a
roots are connectec
of the cerebellum,
gray matter at borc
(Gray). Nerve win
from which it tak
across post. border

to vestibular end of ductus cochlearis, and through 4th macula cribrosa (p. 193) to partition-wall of utricle and saccule. From trunk of nerve a number of fine branches then arise, which pass directly through *tractus foraminosus* (p. 206) to lamina spiralis of lower wall of cochlea. Remainder of nerve enters modiolus, in which it breaks up into fine anastomotic divisions. Bipolar ganglion-cells are connected with the fibres. Bundles traverse *ganglion spiralis* in canalis ganglionaris (p. 195) at beginning of lamina spiralis, and finally pass into latter. Fibres radiate with numerous anastomoses between the two plates of the lamina spiralis throughout all its turns. *Vestibular branch* after its gangliose expansion divides into three branches: (1.) *Superior*, passes through macula cribrosa superior (p. 193) and ends by three branches to utricle and ampulla of sup. vertical and horizontal semicircular canals. (2.) *Middle*, passes through macula cribrosa media to saccule. (3.) *Inferior*, passes through bony canal of its own to ampulla of inf. vertical semicircular canal.

The terminal nerve-fibres pass from the lamina spiralis, through fine holes in labium tympanicum and in memb. vestibularis, into ductus cochlearis. They run radiate course, passing through granular layer, whence some end in inner hair-cells, and others run between rods of Corti, and across tunnel formed by origin and ending

Blood-supply of
auditiva interna
basilar of vertebr
the artery divides i
branches. Former p
post. wall of vestib
latter and of semicir
fine branches thro
into modiolus, and
lamina spiralis. Sc
said to go to labyrin

THE INTERNAL AU
atus auditorius inter
at about the centre o
the temporal b

CHAPTER II.

EXAMINATION AND DIAGNOSIS OF AURAL DISEASE.

TESTS OF HEARING:—A watch is held opposite the ear, and the farthest distance at which its tick is heard is noted. It is usual to make this distance the numerator of a fraction, whose denominator is the distance at which the tick is heard by a normal ear. The letters H. D. are used for designating *hearing distance;* R. E. for *right ear*, and L. E. for *left ear*. For example, if a normal ear hears the watch at 40 in., and the right ear of the patient hears it at only 10 in., we write H. D. R. E. = $\frac{10}{40}$. If the watch is heard only when it touches the auricle, H. D. = $\frac{\text{contact}}{40}$ or $\frac{\text{c}}{40}$. If when pressed against the ear, H. D. = $\frac{\text{pressed}}{40}$ or $\frac{\text{P}}{40}$. If not heard at all, H. D. = $\frac{0}{40}$. Sometimes the watch is only heard when pressed against the mastoid process, H. D. = $\frac{\text{mastoid}}{40}$. The clicking noise made by rubbing the edges of the finger-nails together

stand behind th
distance he can
versation. There
portion between t
scarcely hears a w
versation at fifty
therefore, gives the
hearing-power pres
The tuning-for
whether a lesion of
While vibrating, it
auditory meatus, an
set in vibration th
mastoid process. I
through the air than
conduction better th
ease of the nerve,
ondary, exists. If
through

THE AURICLE is easily examined.

For examining **EXT. AUDITORY CANAL** and *membrana tympani* an aural speculum and mirror are necessary. End of speculum is inserted about ¼ in. into meatus, and held between thumb and forefinger of one hand; at the same time the upper edge of the auricle is held between same forefinger and the middle finger. In this way the auricle can be pulled upward and backward, which obliterates curves of canal, and allows clear view to bottom of it. Parts are illuminated by the *otoscope*—a round, concave mirror about 3 in. diameter, with central perforation—which is held close before the observer's eye at a distance of 6-10 in. from the patient. Either daylight or artificial light may be used; former is simpler, and generally answers every purpose. When both hands are required for examination or for making applications, mirror is held on forehead by an elastic band passing around head.

THE EUSTACHIAN CATHETER AND POLITZER'S METHOD are used to introduce air into the middle ear through the Eustachian tube. Their diagnostic use is to show whether tubes are pervious, and whether predominating elements of disease are such (catarrhal) as can be relieved by inflation. If so, patient will feel the puff of air enter his ear, drumhead will probably be pushed outward and

(2.) Let pat
position and
moisten nostri

(3.) Place fo
upper lip and s

(4.) Hold ca
hand near its la
with the ring c
median line. T
gently into nost
examination, a
entered nose rais
tion and push ca
its beak hugging
to strike the
pharynx.

(5.) Withdraw
it about one-quar
its handl

patient say *hoc* will often answer the same purpose. Difficulties in introducing the catheter are generally due to its being held in wrong position, so that it enters middle meatus of nose; and to patient's spasmodically contracting his facial muscles so as to prevent the necessary relaxation of the parts. Sometimes the manipulation is made difficult or impossible by a very crooked or occluded nostril.

POLITZER'S METHOD [*Adam Politzer, Vienna, 19th cent.*] of inflating the middle ear consists in forcing air through the nostril and Eustachian tube during act of swallowing, which opens tube (?) bringing uvula against pharyngeal wall, shutting off upper from lower pharyngeal space. Patient takes a little water in his mouth and holds it until a given signal. Nozzle of an air-bag is then inserted into his nose and both nostrils tightly squeezed together around it. Signal is then given, and, as patient swallows the water, air-bag is compressed and air forced in. When it is very difficult to make air enter the ear, it may often be done easily by mingling a little chloroform vapor with it. This is done by putting two or three drops of chloroform on the little sponge contained in the bulb of the improved Politzer's apparatus now generally used. For children, Politzer's method is best used by means of a simple piece of rubber tubing, through which air is blown directly from surgeon's lungs. If child is too young to swallow water at a given

sists in taking a
forcing the air o
cheeks and infla
and nostrils are
frequent use cong
drum-head ; and,
methods, it shoul

Some pass sle
catheter to examin
Their use is dan
caution. *(See p. 2*

THERAPEUTICS

SYRINGING THE

ottom of it. As a rule, only simple water
hould be used, and as warm as can be borne
omfortably.

THE AURAL DOUCHE: Is used where *a*
teady flow of warm water is required,—as in
cute inflammations. Douche consists of a cup
hold the water, with a piece of rubber tub-
g attached. Cup is placed above the head, so
at the water runs through the tube and into
e ear from its own weight. Force of stream
an be regulated by height of cup, and should
e very gentle. Ordinary *fountain syringe*
akes a very convenient douche.

If all syringing causes pain or vertigo,
ater may be dropped into the ear from a
onge: or, a camel's-hair brush may be used
clean the ear.

THE COTTON-HOLDER:—Is simply a slen-
r steel probe, around whose end a little
tton can be wound. Used to cleanse and
y the deep parts of ear and to make applica-
ns to them. Should only be used under
d illumination from otoscope. Cotton
uld be very soft and clean.

EECHES: In inflammations of external
itory canal or middle ear, should be
lied at base of *tragus*, on front wall of
al, or on mastoid process, for reason
at these points vessels which supply
ased parts are most conveniently and
ly reached. Cotton should be placed
eatus to keep leech from crawling in.

By using leech-glass and
draw a little blood, the leec
the exact spot desired. Aft
be encouraged for an hour o
it can be checked with styp

BLISTERS BEHIND THE
very little use in chronic infla
acute attacks, where promp
needed, they merely add to
fort.

POULTICES: Injurious as a
inflammations, tend to make
tous and to favor its breaking
needed to quiet pain, should
shape, small enough to be pus
tus, and only applied for a shor

MEDICATED SOLUTIONS to be
the ear should always be warmed.
by holding them in spoon or tes
flame.

INFLATION OF MIDDLE EAR: (

PARACENTESIS OF MEMBRAN
NI [Riolanus, Paris, 1650]: Often
in acute inflammation of middle
large a speculum as possible is u
while ear is well illuminated by
mirror, paracentesis-needle is pass
floor of meatus until drum-head is
Membrane can then be pierced at a
desired. After incision it is usual
ear by Politzer's or Valsalvian meth
opens the wound and tends to forc

matter which may lie in the tympanic cavity. Paracentesis is also performed for chronic cases of non-suppurative inflammation, its principal use being to facilitate medication of middle ear.

TENOTOMY OF TENSOR TYMPANI [Weber-Liel, Berlin, 19th cent.] at its insertion into the malleus is sometimes done, where muscle's contraction appears to cause injurious pressure on fenestra ovalis. Tenotome is passed through ant. segment of drum-head, a little below short process of malleus, and point pushed around behind malleus so as to reach tendon.

DIVISION OF ADHESIONS between memb. tympani and promontory may be successfully done by a knife devised for the purpose.

INSERTION OF AN EYELET INTO MEMB. TYMPANI [Politzer], to preserve a permanent opening, is done. Operation difficult and not free from danger. [The three latter operations are performed in desperate chronic cases, and results thus far have been chiefly negative.]

TREPHINING OF MASTOID PROCESS :—[Petit, France, 1750] (Vide p. 239.)

HEARING-TRUMPETS :—Thus far there are no aids for conducting sound to the ears of persons incurably deaf more efficient than the ordinary metallic or flexible tubes known as hearing-trumpets. (See p. 258).

AUR

1. *Injuries.*
2. *Eczema.*
3. *Tumors.*
4. *Malignant Diseas*
5. *Malformations.*

INJURIES : are of v quire same treatment a

ECZEMA : is quite co associated with eczema canal (vide p. 222). P ances as elsewhere and ment. (See p. 255.)

TUMORS :—comprise *inous;* simple hypertro among negroes ; result c folds of auricle, and causing painful, roundish tumor, of variable size, in which fluctuation may be found; effusion may be absorbed or rupture or suppurate; etiology supposed to be cerebral congestion and centripetal irritation from the emotions; most common among the insane; some advise non-interference, others opening and evacuating sac and use of pressure-bandage; after recovery great deformity is apt to result. Traumatic form is simple extravasation from vessels ruptured by violence, and is not apt to leave deformity.

MALIGNANT DISEASE is very rare; amputation of auricle is the proper remedy.

MALFORMATIONS: may be congenital or result from ill treatment (such as allowing hat to press against auricle, etc.), or from disease. Auricle may be congenitally absent, or rudimentary, generally with same defect of deeper parts. Supernumerary auricles have been observed.

DEPOSITS OF URATE OF SODA are often seen on the auricles of gouty subjects, especially on the helix: sometimes cause considerable pain.

DIFFUSE INFLAMMATION and ABSCESSES of the auricle, from whatever cause, require careful attention, as they tend to produce great deformity.

3. *Diffuse Inflamma*
4. *Circumscribed In*
5. *Eczema.*
6. *Vegetable Fungou*
7. *Polypi.*
8. *Syphilitic Ulcers*
9. *Exostoses and Hy*

FOREIGN BODIES:
their larvæ, and such
tons, peas, beans, etc.,
ear, especially by chi
times fly into ear;
Syringing with warm
them out at once. Th
by the odor of a supp
their larvæ upon the pu
cause pain, or only dis
gling motions. Exami

through indiscreet efforts to remove them; through such attempts, the ear, and even the life of the patient has been destroyed. Beans, peas, etc., are troublesome, because they swell after being in canal for some time. In treating these cases, first thing to do is to examine ear with otoscope; never try to remove a foreign body which you cannot *see*. In ordinary cases, simple syringing will suffice. If body is impacted, and there is inflammation and swelling about it, better to wait until latter subside. If instruments become necessary, patient should be etherized and body dislodged, if possible, by forceps or probe, and then removed by syringe. Value of patient and gentle manipulation cannot be overrated. If foreign body is causing no bad results, there need be no haste about its removal. If instruments really become necessary, they should only be used by a practised hand. Foreign bodies sometimes penetrate into the middle ear, but require no different treatment to that given above.

INSPISSATED CERUMEN, or hardened wax, is quite often found in auditory canal. In majority of cases, probably secondary to some other affection of ear, and should be so considered when complete relief of symptoms does not follow its removal. Wax is not removed by motions of jaw, as it normally is, but collects in canal, its watery parts evaporate, and a brown or black mass is left, some-

because it does not
takes place, althoug
deal of wax present
from any sudden jolt,
with otoscope as da
Simple syringing w
method of removing
cient. Sometimes, wl
a solvent, such as sol
to ℥ i.) may be droppe
times for a day be
begun. Several sittin
remove the wax, and
to doing too much a
be necessary to loose
its hardened surface,
be effectual. Instrume
however, if possible.

Caused by local irritation, such as ear-picks, dropping of oils into ear, etc., and, rarely, by exposure to cold. Symptoms are itching, followed by pain, sense of fulness, and, perhaps, some deafness. Canal and memb. tympani red and swollen, and epidermis and integument may suppurate. Where skin is closely adherent to bone, pain is intense and disease is essentially a periostitis. Treatment in acute stage comprises leeches, incisions, and warm douche; and, if these fail, poultices. If suppuration is established, ear should be thoroughly cleansed every day by syringe, and astringents applied. Solution of alum or zinc (gr. 1–4 to ℥i.) may be dropped into ear by patient, after syringing. Surgeon should cleanse the ear himself 3–4 times a week, and make some appropriate application to the affected part.

CIRCUMSCRIBED INFLAMMATION or FURUNCLE, is a symptom of a wrong state of the system. Apt to occur in anæmic persons, and to be recurrent. Very painful, and may cause deafness by filling up canal. Does not usually cause tinnitus. Proper treatment is to make an incision as soon as possible, whether pus has formed or not, and then to use warm douche freely. Probe is useful to find the most tender point, where furuncle is not very marked. Incision is best made with a *sharp-pointed bistoury*, and should be a deep and *free one.* Leeches are not of much service.

ness and tinnitus, with dea
rarely brought to notice un
chronic. In treatment,
thorough removal of exude
day, and this is best done by
self. Warm douche and cotto
means. After cleansing, an
be applied, a liquid one bein
not clog up the canal. Fre
warm douche by the patient i
ing the canal clear and to
itching.

VEGETABLE FUNGI; sor
ated in auditory canal, an
gravate inflammations of t
commonly secondary to ecze
of *otitis parasitica* are ti
deafness, dull pain, vertigo,
ish flakes adhering to walls o

2. *Penicillium glaucum.*
3. *Graphium penicilloides.*
4. *Tricothecium roseum.*

They can only be seen by the microscope. *Treatment* consists in keeping canal free from fungus and subduing inflammation. Many parasiticides are recommended, but the warm douche thoroughly used is as good as any. Inflammation of canal is treated as usual.

POLYPI: are result of a prolonged or violent acute suppuration, or one that has been augmented by poultices so that integument has been destroyed by ulcerative process. Usually associated with polypi of middle ear and require same treatment (vide p. 236.)

SYPHILITIC ULCERS and CONDYLOMATA; very rare. Require local cleanliness and the proper internal remedies for syphilis.

EXOSTOSES and HYPEROSTOSES, or bony growths. Sometimes occur in osseous part of auditory canal. Most frequently come from chronic suppuration of the middle ear, extending its irritation to the canal, and will therefore be considered under that section (vide p. 237). May be congenital or occur in some special diathesis. If canal is occluded by growth, an operation for opening a passage through it (such as that of boring a hole with a rat-tail file or a dentist's drill) must be performed

ject to injuries from
of condensed air, fr
ments, etc. Memb
from artillery explo
condensed air, as ir
bridge-piers; from
from waves strikir
bathing; from vic
blowing of nose;
straw, etc., thrust i
struments, etc. V
ear, and collectio
and Eustachian t
more liable to ru
traumatic causes th
Rupture of drum-
middle ear belongs
termine the natur

of the middle ear. Meanwhile, the ear should be protected by a bit of cotton placed in meatus, and patient kept under careful but not meddlesome observation.

MYRINGITIS [Lat. *myringa*] or INFLAMMATION OF DRUM-HEAD, is only part of an inflammation of adjacent regions. The anatomical structure of a membrane which has no independent nutrition, which has but one layer of tissue peculiar to itself (and that in its centre), but which is a direct continuation of neighboring parts, rather precludes the idea of its being primarily diseased.

FRACTURE OF THE HANDLE OF THE MALLEUS is very rare, only three or four cases having been reported. The diagnosis in these cases was based upon the peculiar, irregular appearance of the bone.

The principal affections of the middle ear are :

1. *Acute Catarrhal Inflammation.*
2. *Subacute Catarrhal Inflammation.*
3. *Chronic Non-Suppurative Inflammation.*
   (a.) *Catarrhal.*
   (b.) *Proliferous.*
4. *Acute Suppurative Inflammation.*
5. *Chronic Suppurative Inflammation.*
6. *Consequences of Chronic Suppuration.*
   (a.) *Polypi.*
   (b.) *Exostoses.*
   (c.) *Mastoid disease.*

ACUTE CATARRH
quite common. Has
exposure to cold an
water to run into ear ;
constitutional diseases
measles, small-pox, pn
of "nasal douche," etc
instrument probably du
of the water through
into tympanum. Ac
starts from faucial en
but may sometimes ext
canal. *Symptoms* are p
tinnitus ; impairment
swelling, and bulging o
pani ; catarrh of pha
tube ; fever, and, rarel

tressing. Deafness may not be marked in stage of pain; indeed, hearing sometimes seems more acute than normal. Redness of memb. tympani may be confined to periphery and along malleus-handle, or be intense over whole membrane, effacing all its normal appearances. Bulging outward of the membrane may often be seen after the first 48 hours of the attack, generally in posterior part, and in Shrapnell's membrane. Spontaneous perforation is then apt to follow. Fever, and even delirium, are sometimes present.

Treatment should be antiphlogistic and prompt. First remedy in efficiency is local blood-letting by one to four leeches to the tragus (p. 213). Next is warm water poured into the ear by the douche so as to give it a continuous bath. Douche may be used for several minutes every half-hour. Breathing into the ear, steaming it, and blowing in of tobacco-smoke are sometimes useful to quiet the pain. Poultices should only be used when other measures fail, as they are dangerous to the integrity of the drum-head. Dropping of oils, molasses, etc., into the ear is useless, and only clogs up the canal. A little laudanum may be added to the warm water, if desired, and opium may be given internally. If perforation of memb. tympani is threatened, a paracentesis should be performed; or it may be done to relieve the pain where other means have failed, even when there is no bulging

visable when
out secretion

Such promp
a perfect cure,
otitis and its b
tion occurs, it

Several cases
in which the co
perforation wit
abundant hemor
In other cases o
centesis has be
caped from the t
to such cases is
[Hemorrhage int
occur from ather
disease.] (See p.

SUBACUTE CA

care; such as regulation of diet, attention to skin, proper exercise, etc. Tonics and attention to pharynx are important. The use of the catheter (except in children) and Politzer's method generally restore the hearing—in some cases almost immediately.

The non-suppurative inflammations are described separately for convenience, but it must be remembered that in practice the line of separation between them is not always well marked:—

CHRONIC CATARRH OF THE MIDDLE EAR: Forms a large proportion of the cases presenting themselves for treatment. It is either a consequence of acute catarrhs, or supervenes upon chronic catarrh of the throat, especially in constitutions enfeebled by disease or bad hygiene. Patient has the usual symptoms of chronic naso-pharyngeal catarrh. In addition, he has occasional sounds in his ear like crackling of air-bubbles; sense of fulness; tinnitus; deafness; sometimes vertigo. Tinnitus is very annoying, causes great depression, sometimes resulting in suicide. Noises variously described as buzzing of insects, rushing of water, ringing of bells, etc., etc. There are also changes in the memb. tympani, and imperfect action and changes in structure of Eustachian tube. Appearances of drum-head are valuable in connection with other signs, but not always diagnostic, as many of them may also

handle ; by diminutic
of the light spot ; an
appearance of the
describe. There ma
lustre of the memb
calcareous deposits
its natural mobility
preternaturally mobi
while patient perforn
or by Siegle's otosco
and Eustachian tube
presents familiar a
catarrh. Often it is
elevations, constitutin
Rhinoscope shows s
mouth of Eustachian
able as a *sound* for d
of the nasal mucous n

to take cold will assist in relieving chronic aural catarrh. Attention to skin, daily sponge bathing and frictions, Turkish baths, etc., are very useful. Treatment of pharynx and nose very necessary. Injections of the naso-pharyngeal space by a long syringe made for the purpose, are useful to dislodge collections of matter, if for nothing else. Various solutions are used in the syringe, of which those of salt and chlorate of potash are most common. Nasal douche dangerous, as it has often caused acute inflammation of middle ear, even when all precautions had been observed in its use. Better to wash out nostrils with Davidson's syringe by *gentle and intermittent* current. Same solutions are used as in post. nares syringe. The applications to be made to the nasal and pharyngeal mucous membrane will, of course, vary with different practitioners. A gargle is a matter of individual choice. Saturated sol. chlorate of potash as good as any for ordinary purposes. Tröltsch's method of gargling is useful as *gymnastic exercise* for muscles of tube, aside from its effect on mucous membrane :—The gargle is held in back part of mouth, the head thrown well back, and the nostrils closed with the fingers ; swallowing motions are then performed without actually swallowing the solution. Eustachian catheter is used for treating tube and tympanic cavity. Simple air blown through it is most universally useful. Steam,

in course of disease,
etc., should be tried

CHRONIC PROLIF
—In this form, the s
hearing and tinnitus,
catarrhal form. The
patient's history does
aches, coryza, frequen
that disease has begu
ously, that it has got
essentially impaired
has noticed it. The
catarrh, no closure of
ing pointing to an
pharynx, tubes or ty
an opposite state of
to be adhesions in t
sunken and immova

and tympanum by dense fibrous tissue, hypertrophy of bone, etc.

Treatment: like that of catarrhal form, excepting that pharynx does not usually need attention.

In many of the cases of non-suppurative inflammation, a *cure* is out of the question, and the best that can be hoped for is to alleviate the condition or keep it stationary. Hygienic treatment should be kept up during patient's life. Local treatment, if it does any good, may be given for from 1—2 months, twice a year. Some cases progress in spite of every remedy. For inveterate cases which resist all ordinary treatment, such operations as exhaustion of air from drumhead, maintaining permanent opening in it, and division of tensor tympani are sometimes performed. They are only to be undertaken by a skilled surgeon, and indications for them will be found in larger text-books. As a rule, they are not productive of much benefit.

ACUTE SUPPURATION OF MIDDLE EAR: usually a direct result of acute catarrh, and preceded by its violent and painful symptoms (p. 226). In many cases, however, latter process is unobserved and discharge of pus is first thing noticed. In cases occurring from scarlet fever, measles, etc., catarrhal stage apt to be overlooked because of grave symptoms of the general disease. Causes are same as those of acute catarrh, exposure to cold being most

tends to brain through
or produces pyæmia
vein.

Treatment: In early st
membrane seems about t
should be done in most b
If mastoid is red, swollen
sion should be promptly
(p. 238). Ear should be
with warm water. If me
ruptured, ear should be
least twice a day by syri
weak astringent, such as
ii. to ℥i.) may be dropp
may be done by patient h
be cleaned and astringent
every other day, if p
method may be used gen
to blow secretions from
vent formation of adh
plan, case usually progres

lent discharge. This may be profuse or scanty, or only periodic. In latter case, mass of dried pus may be found in canal and tympanum when ear is examined. Drum-head may be swept away and ossicles also; or there may be a rim of it left with one or more of the ossicles in place or dislocated; or there may be one or more cleanly-cut holes in it, with ossicles in position. Sometimes, perforation is very small and only detected by having air blown through it from Eustachian tube, when the "perforation-whistle" will be heard, or a drop of pus blown out through it. *Pulsation* at bottom of canal is suspicious but not pathognomonic of perforation. Depends on layer of fluid in contact with beating blood-vessel. Pharynx and Eustachian tube usually in catarrhal state, and general health below normal. Degree of deafness variable, depending as it does on many factors. Course of disease tedious and requires very patient treatment. In some cases, suppuration never is permanently subdued. Anatomical relations of tympanic cavity show the danger of allowing disease to proceed unchecked. (p. 236). (See p. 255.)

Treatment:—First requisite is *cleanliness.* Ear should be syringed once or twice a day. (p.212.) Should be cleaned by surgeon himself as often as he may think best. Politzer's method is an aid in blowing secretions out of *tympanic cavity* and breaking up adhesions

If drum-head i
over the expo
Various solutio
1–5 to ℥ i. ; ar
cupri sulph. gr
1–5 to ℥ i., &c
blown into the
bismuth, salicyli
be changed now
After irritation
sided, hearing m
by insertion of an
is only of service w
wholly destroyed,
marked. It mus
removed at once if

CONSEQUENC

calibre of tube. Fibres said to pass into those of tensor tympani. Supplied by internal pterygoid nerve.

Levator veli palati: O. lower surface of temporal bone on ant. border of entrance to carotid canal, and from cartilage of tube. I. in region of osseous tube on bone, cartilage and mucous memb. of tube. Presses membranous floor of tube forward, enlarging transverse diameter. Supplied by pneumogastric nerve.

Salpingo-pharyngeus: Thin muscular layer connected to lower end of median cartilage, to mucous memb. and post. wall of pharynx. Considered as fixator of median cartilaginous plate. Called fascia by some.

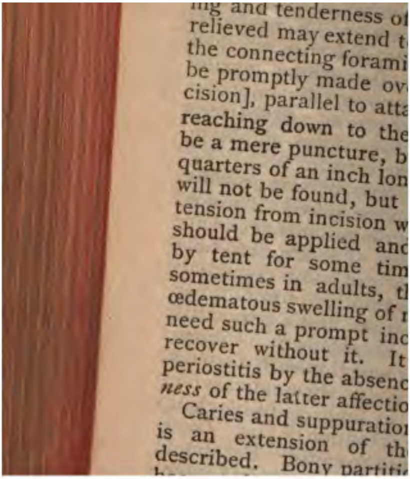
Vessels of tube: Ascending pharyngeal from ext. carotid. Middle meningeal from int. maxillary. Branch from int. carotid.

Nerves of tube:—Branches to muscles *q. vide.* Sup. pharyngeal from 5th. Glosso-pharyngeal.

Whether tubes are normally open or closed is disputed. They are opened during act of swallowing. A semi cylindrical space under hook of cartilage is called *safety-tube,* and supposed to be always open.

INTERNAL EAR, OR LABYRINTH.

Is the *essential* part of the hearing apparatus, *containing* the ultimate filaments of the



ing and tenderness o
relieved may extend t
the connecting forami
be promptly made ov
cision], parallel to att
reaching down to the
be a mere puncture, b
quarters of an inch lon
will not be found, but
tension from incision w
should be applied anc
by tent for some tim
sometimes in adults, t
œdematous swelling of
need such a prompt inc
recover without it. It
periostitis by the absenc
ness of the latter affectio

Caries and suppuratio
is an extension of th
described. Bony partiti

be enlarged to give exit to pus. If there is no fistula mastoid must be trephined, if there is suspicion of caries or retained pus. The periosteum is first dissected up, and a small trephine worked *carefully* in a direction inward, forward and upward. Cell-structure is usually reached at depth of $\frac{1}{6}$–$\frac{1}{4}$ inch. Wound should be dressed from bottom with lint and kept open for some time. (See p. 258.)

Caries and *Necrosis of Temporal Bone:* may occur from chronic suppuration of middle ear, and maintain the discharge of pus in spite of all efforts to stop it. Spot of diseased bone may be very minute or quite extensive. Use of probe for diagnosis must be very cautious. From relations of tympanic cavity, caries of its walls is very dangerous. In some cases, diseased bone is thrown off and parts heal. Nearly whole petrous bone has been exfoliated in this manner. Fatal hemorrhage has occurred from caries of walls of carotid canal, lateral sinus and jugular vein.

Cerebral Abscess: Suppuration of middle ear is most common, single cause of cerebral abscess—especially where there is not a free exit for pus. Symptoms of extension to brain sometimes insidious. May be a chill or convulsion, nausea and vomiting. Or, increased pain, followed quickly by paralysis, coma, and death. Or death may occur suddenly without being preceded by brain symptoms.

Pyæmia or Metastatic Abscesses may occur

Paralysis of 7th ne
tympanic cavity in
sult from suppuratio
ear. May be tempo
nerve; or permanent

INTERN

NERVOUS DEAFNES
auditory nerve or laby
mary nervous deafness
diseases. Secondary
extending from middl
frequent. Primary di
injury, such as fract
from hemorrhage o
labyrinth through d

Symptoms: 1. Patients hear better in a quiet place. 2. Noise is often distressing. 3. The tuning-fork C^2 is heard better through the air than through the bones. 4. Absolute deafness. In the latter case disease invades the nerve in its trunk or expansion. Staggering gait or loss of equilibrium is also a symptom of disease of the cochlea. Many cases in which latter symptom was marked have been wrongly classified as *Menière's disease,* after Dr. P. Menière, of Paris, who recorded several such cases. Only autopsy he made showed disease *confined to semicircular canals,* but the case was not a fair type of the others. Such symptoms as *partial* deafness, tinnitus, vertigo, nausea and vomiting, occur also in affections of the middle ear,—but nausea and vomiting are rare unless labyrinth is involved. There are no appearances of membrana tympani that give evidence of disease of internal ear. Disease of cochlea produces deafness to certain tones. This symptom, however, as well as "double hearing" (hearing last notes repeated or echoed) may be secondary to disease of middle ear causing pressure on labyrinth. (See p. 256.)

Treatment: each case must be treated according to its symptoms. In acute inflammatory disease, cold applications to head, leeches, counter-irritation and avoidance of quinine would be indicated. Effusions due to syphilis, except in first amenable to treatment than ary venereal disease. Chro labyrinth are hopeless thus strychnia, etc., have accomp

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DEAF-MUTEIS

Is not a primary affectio condition secondary to disea defect of the auditory ap reason that deaf persons b that affection of ear is prese shortly after that its victim and imitate speech. Deaf- into two classes: (1) The co the acquired. Probably th fully as large as the former. quire absolute deafness in produce deaf-muteism. A catarrh that would only i adult, may make an infant so soon cease to attempt to imi

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OTALGIA,

or pain in the ear, is very r affection. It may occur fro *ilis*, carious teeth, etc.

BIBLIOGRAPHY.

Handbuch der Anatomie des Menschen. J. Henle, Braunschweig, 1866.

Traité D'Anatomie. Ph. C. Sappey, Paris, 1872.

Handbuch der Lehre von den geweben des Menschen und der Thiere. S. Stricker, Leipsig, 1872.

Handbuch der gesammten Augenheilkunde. Graefe und Saemisch, Leipsig, 1874.

Gray's Anatomy, Descriptive and Surgical. Philadelphia, 1862.

Physiology of Man. Austin Flint, Jr., N. Y., 1874.

Anatomie und Physiologie des Auges. Heinrich Müller, Leipsig, 1872.

Treatise on Diseases of the Eye. Dr. Carl Stellwag (von Carion). Translated by Drs. Roosa, Hackley and Bull, N. Y., 1873.

Diseases of the Eye. J. Soelberg Wells, Am. Ed., *Phila., 1873.*

Accommodation and R
Donders. Translat
1864.

Lehrbuch der Ophthal
ner, Wien, 1868.

Treatise on Diseases of
B. St. John Roosa,

The Membrana Tymp
Dr. Adam Politzer.
son and Newton, N.

Die Mechanik der
Trommelfels. H. H

Atlas des menschlichen
dinger, München, 18

Wandtafeln zur anatom
Adam Politzer, Wien.

Chirurgie Oculaire. D

Ocular Therapeutics.

APPENDIX.

Page 15. The text-books state that the muscular element of the ciliary body was discovered independently by Brücke and Bowman in 1846. Wm. Clay Wallace, an oculist of New York City, discovered and described it in 1836.

Page 20. *The retinal purple, visual purple, or Seh-purpur.*—This is a purplish coloring of the external layer of the retina, which has been specially studied and described recently by Prof. Boll, of Rome, and Prof. Kühne, of Heidelberg. It has been found in most animals examined. It is destroyed by the action of daylight, and restored again by darkness. It disappears after death. Its restoration during life is thought to be a function of the epithelial layer lying between the retina and the choroid. Some animals seem destitute of it, and it is not proven to exist in the *fovea centralis* of man. Hence it cannot be said to be essential to the perception of light. It is thought to contribute to the reddish color seen on looking into the eye with the ophthalmoscope.

Page 50. *The metric system as applied to lenses.*—In the old system a *strong* lens, of one inch focus, is *taken as the unit.* This necessitates the use of

fractions. For example, a lens o
is only $\frac{1}{24}$ as strong as the unit
must be designated by $\frac{1}{24}$; a le
cus is $\frac{1}{10}$, etc. In making calc
always to add or subtract fracti
convenient. In the metric syste
weak lens, of one metre focal
called a dioptric (D). It is abou
lens of the old system. The str
multiples of the unit. Calcul
made, as we deal only with whol
example, a lens twice as strong a
of two dioptrics, 2 D ; one three
is 3 D ; one half as strong is .5
thalmoscopes and cases of trial-
numbered according to both syste

Page 112. *Keratitis bullosa* is
corneal inflammation whose cause
characterized by a localized inf
deeper layers of the cornea, ove
parent vesicle forms and breaks,
ficial ulcer. After the breaking
repair is rapid. The disease is at
pain and great spasm of the lids.
intra-ocular pressure is increased
slight tendency to suppuration or
cornea, or to invasion of neig
There seems to be some connecti
disease and acute glaucoma. Th
tendency to relapses. Treatment
ing of the vesicle, scarifications
atropine, eserine, heat, paracentes
if the intra-ocular pressure is in

mic injections of morphia for the spasm of the lids. Recovery generally takes place with no worse damage than opacity of the cornea.

Page 108. *Keratoplasty* is an operation designed to remedy loss of vision from opaque cornea. It consists in excising a small piece of the cornea and replacing it by transplanting a graft of transparent cornea from another eye. The graft is taken, together with some flaps of the adjoining conjunctiva, from a freshly-enucleated human eye. It is accurately fitted to its new position and retained there by stitching the conjunctival flaps into openings in the ocular conjunctiva made to receive them.

Page 115. *Iritis Spongiosa* is a rare form of iritis which has been observed to occur independently, or combined with the plastic variety. It is characterized by a peculiar fibrinous exudation, which usually begins near the pupillary space, and spreads thence until it fills the whole anterior chamber; sometimes this occurs very suddenly; the exudation often looks like the lens dislocated into the anterior chamber; absorption usually takes place slowly, beginning at the periphery. Iritis Spongiosa has the same causes as other kinds of iritis. The prognosis is good, and unless combined with the plastic form no adhesions are left. The treatment is the same as that of the plastic form.

Page 136. *The use of magnets* has been *proposed* [*McKeown*, Belfast, Ireland, 1874,] *for re-*

magnet is used, and its
point, so that it can be i
It is very useful as a
wound for a piece of
seen. Or, it may be in
cision specially made fo
about outside the eye it n
within to move, and it h
agnosis in doubtful case
magnetic needle has als
caused by a piece of
[Pooley, New York.]

Page 142. *Glaucoma.*—
ly that sulphate of eserin
uable remedial powers in g
In certain cases of acute
tension, improves the visio

to vestibular end of ductus cochlearis, and through 4th macula cribrosa (p. 193) to partition-wall of utricle and saccule. From trunk of nerve a number of fine branches then arise, which pass directly through *tractus foraminosus* (p. 206) to lamina spiralis of lower wall of cochlea. Remainder of nerve enters modiolus, in which it breaks up into fine anastomotic divisions. Bipolar ganglion-cells are connected with the fibres. Bundles traverse *ganglion spiralis* in canalis ganglionaris (p. 195) at beginning of lamina spiralis, and finally pass into latter. Fibres radiate with numerous anastomoses between the two plates of the lamina spiralis throughout all its turns. *Vestibular branch* after its gangliose expansion divides into three branches: (1.) *Superior*, passes through macula cribrosa superior (p. 193) and ends by three branches to utricle and ampulla of sup. vertical and horizontal semicircular canals. (2.) *Middle*, passes through macula cribrosa media to saccule. (3.) *Inferior*, passes through bony canal of its own to ampulla of inf. vertical semicircular canal.

The terminal nerve-fibres pass from the lamina spiralis, through fine holes in labium tympanicum and in memb. vestibularis, into ductus cochlearis. They run radiate course, passing through granular layer, whence some end in *inner hair*-cells, and others run between *rods of Corti*, and across tunnel formed by

action is shown
mouth of the follicle. If
ceeded, the hair, in case it
can be extracted with very

Page 158. *Ephidrosis*
tion of the sweat-glands
itching and biting sensati
inflammation of the skin
It is difficult of cure.

Chromhidrosis is a dar
oration of the skin of the li
and capable of being wash
water. Seen chiefly in
supposed by some autho
simulation.

Xanthelasma, *Xanthom*
pears as peculiar yellow
on the skin of the eyeli
upper lid, near the inne

opia or hypermetropia represents the degree of the refractive-defect *practically*, because it is held at about the same distance from the eye as would be the correcting spectacles. But to estimate the refraction *accurately*, we must consider the distance between the glass and the nodal point of the observed eye. In myopia the correcting-glass is stronger, and in hypermetropia weaker, than it would be if it could be placed at the nodal point. Hence, to obtain the exact degree of the myopia we add to the denominator of the fraction representing the focal length of the correcting-lens its distance from the nodal point. If the fundus is seen clearly through a $-\frac{1}{8}$ held 2 inches away, the real degree of myopia is $\frac{1}{8+2}=\frac{1}{10}$. In hypermetropia we subtract the distance. If the fundus is seen best through a $+\frac{1}{8}$, held 2 inches away, the real degree of the hypermetropia is $\frac{1}{8-2}=\frac{1}{6}$.

Page 188. The dimensions of the ossicles are: Length of *malleus* from summit of head to short process, about 4½ millimetres; from short process to end of handle, 4 to 5 mm.; long process, about 2 mm. Length of *incus* from summit of head to end of long process, about 6½ to 7 mm.; to end of short process, about 5 mm. Length of *stapes*, about 3 mm.; greatest distance between crura, about 2 mm.; length of base, about 3 mm.; width, about 1 mm.

The long process, or processus Folianus [Cœlius Folius, Venice, 1645,] of the malleus, is also called the process of Rau, after Prof. Jacob Rau, of the *University* of Leyden.

to a small column o
steel hammer is sus
hammer can be depre
when liberated the h
der and sets it into vi
tuned to C^2, and it gi
sity and pitch, and lo
It is heard on the ave
is a pin fastened to th
metal disc on its end.
the skull if it is desire
testing bone-conductio

Page 208. It is alw
aerial and *bone-conducti*
normal ear hears the
through the air than
the auditory nerve is
fork is almost alway
bones than through th

duction is better in the latter position than in the former.

The chief reason why a tuning-fork held on the teeth or the vertex is heard better in the deafer ear, when the deafness is due to disease in the conducting portions, is, that the escape of the vibrations outward through the drum and auditory canal is *obstructed*,—more of them are thrown back upon the nerve, and the latter thus perceives the sound intensified. If, in such a case, the meatus is also plugged by the finger, the sound will be still further increased on that side. It is thought that when plugging the canal in this way does *not* intensify the sound, this fact is proof that the auditory nerve is involved : this view is not held by all surgeons.

The tuning-fork held on either parietal protuberance is heard better *in the opposite ear* in a normal case. This is still more noticeable if that ear is the seat of disease confined to the conducting portions.

Testing the hearing in one-sided deafness requires great care, owing to the difficulty in excluding the good ear. The following methods are useful :

Stop the better ear, and direct it toward the source of sound ; then test the hearing, with the deaf ear alternately open and closed : if there is any difference found by the two tests, the balance is credited to the worse ear. [Dennert & Lucae, Berlin, 19th cent.]

Stop the affected ear, and pass a vibrating tuning-fork back and forth alongside of it. If the *sound is not* increased as the fork nears the

there is no difference, th
affected ear is totally de
reached the auditory nerve
the bones. But if stoppin
the hearing worse, repeat
they are heard again. T
the hearing distance by
second will represent the
the affected ear,—consequ
distance by aerial conduc
delphia.]

Page 212. *Several usefu*
zer's method of inflation
Gruber [Vienna, 19th cent
patient, instead of swallow
or *hoc;* Dr. Tansley [Ne
forcibly with puckered lip
land, Me.], that he close
tend his mouth and cheek

Emphysema sometimes occurs over the mastoid process, the air escaping by way of the middle ear and mastoid cells, through a congenital fissure in the bone.

Page 216. *The auricle* is subject, also, to erythema, erysipelas, herpes, syphilitic eruptions, frost-bite, etc. If any cold fluid is used in treatment, it should not be allowed to run into the auditory canal, lest it may excite inflammation of the deeper parts of the ear. In cases of frost-bite, it is necessary to guard against too sudden reaction: the auricle should be bathed with very cold water at first, and warmer applications made gradually.

Page 228. Sometimes *exudations of serous fluid into the tympanum* (hydro-tympanum) occur without any active inflammatory symptoms. The patient complains of deafness, a sense of stiffness, and, perhaps, of pressure. On inspection, the level of the fluid may be seen through the drum-head, and this may alter with a change in position of the patient's head; or bubbles of fluid may be seen behind the membrane; or there may be nothing evident save some slight alteration in the translucency of the part. Inflation, paracentesis, and attention to the throat and general condition are the chief means of treatment.

Page 235. *Pulsation of the membrana tympani, without perforation*, has been observed in rare instances. A few cases have been reported where the pulsation seemed to depend upon a vascular

Page 23
been succes
cial drum-h
the middle
to transpla
forearm, ei
of the tym
the drum-h
previously
ing, as of b
is not likel
charge has
upon two c
The first c
thold, oper
in the *Mor*
vember, 18

Cophosis
times used

Hyperact
hearing,]

other ear ; that is, two distinct sounds are heard simultaneously, one true the other false. This is double hearing in the strictest sense of the term. This condition has been called ***diplacusis binauricularis.*** The condition which is much more common, and which is frequently described as double hearing, is that in which the last notes are heard repeated or echoed. Thus, the sounds are heard correctly until just at the close, when there is an echo-like repetition of higher pitch in the affected ear. Sometimes the same condition prevails in both ears, and all notes are heard falsely. These peculiar alterations in perception usually affect only the higher notes of the scale. Double hearing is most frequently complained of by people having a musical education, and it is more annoying to such persons than to others.

Page 220. *Ear-cough, ear-sneezing, ear-vomiting.*—Coughing, sneezing, and vomiting from irritations about the external auditory canal have been observed for centuries. Impacted wax or foreign bodies in the canal have been common causes. The phenomena are probably due to irritation of the branch [Arnold's nerve] of pneumogastric nerve, distributed to the walls of the external auditory canal. The text-books do not agree as to the existence of this branch in the canal, except as an anomaly. As good authorities as Sappey and Gruber describe it. Some authors ascribe ear-cough, etc., to irritation of the auriculo-temporal branch of the fifth nerve, and say that the communication with the pneumogastric occurs in the brain.

Page 220. *Objective noises in t*
present in quite a number of
They are heard by the patient
also audible to others, sometimes
several feet. They are compare
râles, or to the sound produced
edges of the finger-nails togethe
the hair between the thumb an
the ear. They are usually accom
modic contractions of the mus
palate and throat, and sometimes
movements of the drum-head.
they can be produced voluntarily.
them due to contractions of the
muscle. Most authorities think
their origin at the pharyngeal mo
chian tube, being caused by a se
moist lips of that orifice. In on
thought to be due to spasmodic c
stapedius muscle. Sometimes th
mal, sometimes it is temporaril
the noises are occurring, sometin
permanently impaired. Often t
disease present. The cause of
twitchings of the muscles is obscu

Page 239. Several cases of *pr*
the mastoid process have been rep
periostitis, abscess, and caries hav
out any apparent connection with
ease of the latter having been
most careful examination.

Page 215. The *Audiphone* a

Since the first edition of this book appeared, two useful instruments have been invented for aiding the deaf to hear. The *Audiphone* was invented by Mr. R. S. Rhodes, of Chicago, Ill. It consists of a thin and elastic diaphragm of hard rubber fitted to a handle, so that the whole looks much like a fan. The upper edge of the diaphragm is bent toward the lower by silken cords attached to it, so that a convex surface is presented toward the source of sound, and a concave one toward the listener. The tension of the diaphragm can be regulated by the cords as best suits each case. In using the instrument, the upper edge is pressed firmly against the central incisors or the eye-teeth of the upper jaw.

The *Dentaphone* is a small circular box, fitted with a very delicate vibrating diaphragm, to which is attached a silken cord connected at its other end with a wooden tooth-piece. The receiver is held in the hand with the diaphragm directed toward the source of sound, while the piece of wood is held between the teeth, the intervening cord being kept quite tense.

By both these instruments the sound-vibrations are conveyed to the auditory nerves by way of the bones of the skull. Hence they are only useful in those cases of deafness which are situated wholly or chiefly in the *conducting* portions of the ear. Their usefulness is in proportion to the integrity of the nervous apparatus. Like speaking-tubes, they prove of decided benefit in a limited number of cases.

(πρεσβυς, *an old man;*
It is claimed that the ears
fifty years of age under
which cause impairmen
cially in noisy places, or
sons are conversing. T
of this condition are
noise and greatly dimini
tion. The pathology o
be shrivelling of aural t
of the accoustic ner
Green).

GLOSSARY.

The definitions of the words given below can be found by means of the page-references and index.

Amaurosis. Gr. *αμαυροω, to render obscure*, p. 141.
Amblyopia. Gr. *αμβλυς, dull*, and *οψις, vision*, p. 141.
Ametropia. Gr. *α, privative ; μετρον, measure ; οψις, vision*, p. 162.
Ampulla. Lat. *ampulla, a flask*, p. 193.
Anchyloblepharon. Gr. *αγκυλωσις, a stiffening*, and *βλεφαρον, eyelid*, p. 97.
Annulus tympanicus. Lat. *annulus, a ring*, and *tympanicus, tympanic*, p. 179.
Anopsia. Gr. *ανα, without*, and *οψις, vision*, p. 141.
Antrum. Lat, *antrum, a cave*, p. 189.
Aphakia. Gr. *α, privative*, and *φακος, lens*, p. 168.
Arcus senilis. Lat. *arcus, a bow*, and *senilis, senile*, p. 39.
Asthenopia. Gr, *ασϑενης, weak*, and *οψις, vision*, p. 162.
Astigmatism. Gr. *α, privative*, and *στιγμα, a point*, p. 166.
Auricle. Lat. *auricula, the external* ear, p. 176.

because it does not occu
takes place, although the
deal of wax present; im
from any sudden jolt, etc.
with otoscope as dark m
Simple syringing with
method of removing wax,
cient. Sometimes, where
a solvent, such as sol. sod
to ℥ i.) may be dropped in
times for a day before
begun. Several sittings m
remove the wax, and the
to doing too much at on
be necessary to loosen m
its hardened surface, so th
be effectual. Instruments s
however, if possible. All

Caused by local irritation, such as ear-picks, dropping of oils into ear, etc., and, rarely, by exposure to cold. Symptoms are itching, followed by pain, sense of fulness, and, perhaps, some deafness. Canal and memb. tympani red and swollen, and epidermis and integument may suppurate. Where skin is closely adherent to bone, pain is intense and disease is essentially a periostitis. Treatment in acute stage comprises leeches, incisions, and warm douche; and, if these fail, poultices. If suppuration is established, ear should be thoroughly cleansed every day by syringe, and astringents applied. Solution of alum or zinc (gr. 1–4 to ℥ i.) may be dropped into ear by patient, after syringing. Surgeon should cleanse the ear himself 3–4 times a week, and make some appropriate application to the affected part.

CIRCUMSCRIBED INFLAMMATION or FURUNCLE, is a symptom of a wrong state of the system. Apt to occur in anæmic persons, and to be recurrent. Very painful, and may cause deafness by filling up canal. Does not usually cause tinnitus. Proper treatment is to make an incision as soon as possible, whether pus has formed or not, and then to use warm douche freely. Probe is useful to find the most tender point, where furuncle is not very marked. Incision is best made with a sharp-pointed *bistoury*, and should be a deep and *free one*. Leeches are not of much service.

ness and tinnitus,
rarely brought to r
chronic. In trea
thorough removal
day, and this is bes
self. Warm douche
means. After clean
be applied, a liquid
not clog up the can
warm douche by the
ing the canal clear
itching.

VEGETABLE FUN
ated in auditory ca
gravate inflammation
commonly secondary
of *otitis parasitica*
deafness, dull pain,

Hyperacusis. Gr. ὑπερ, *beyond*, and ακουη, *hearing*, p. 256.

Hypermetropia. Gr. ὑπερ, *beyond*; μετρον, *measure*; and οψις, *vision*, p. 162.

Hypometropia. Gr. ὑπο, *under*; μετρον, *measure*; οψις, *vision*, p. 161.

Hypopion. Gr. ὑπο, *under*, and πυος, *pus*, p. 138.

Incisuræ. Lat. *incisura, an incision*, p. 179.

Incus. Lat. *incus, an anvil*, p. 185.

Infundibulum. Lat. *infundibulum, a funnel*, p. 195.

Iridectomy. Gr. ιρις, *the iris*, and εκτομη, *a cutting out*, p. 73.

Irideræmia. Gr. ιρις, *the iris*, and ερημος, *wanting*, p. 118.

Iridodesis. Gr. ιρις, *the iris*, and δεω, *to bind*, p. 73.

Iridodonesis. Gr. ιρις, *the iris*, and δονεω, *to tremble*, p. 117.

Iridotomy. Gr. ιρις, *the iris*, and τομη, *a cutting*, p. 73.

Iris. Gr. ιρις, *a rainbow*, p. 16.

Keratitis. Gr. κερας, *cornea*, and *itis*, *denoting inflammation*, p. 99.

Keratocele. Gr. κερας, *cornea*, and κηλη, *a hernia*, p. 103.

Keratonyxis. Gr. κερας, *cornea*, and νυσσω, *to puncture*, p. 74.

Lachrymation. Lat. *lacryma*, *a tear*, p. 89.

Lacus. Lat. *lacus*, *a lake*, p. 33.

Lagophthalmos. Gr. λαγως, *a hare*, and οφθαλμος, *eye*, p. 157.

ject to injuries from co
of condensed air, from
ments, etc. Membran
from artillery explosio
condensed air, as in cai
bridge-piers ; from blo
from waves striking s
bathing ; from violent
blowing of nose ; from
straw, etc., thrust into e
struments, etc. Wher
ear, and collection of
and Eustachian tube,
more liable to rupture
traumatic causes than wh
Rupture of drum-head
middle ear belongs unde
termine the nature of a

Onyx. Gr. *ονυξ*, finger-nail, p. 102.
Ophthalmoscope. Gr. *οφϑαλμος*, *eye*, and *σκοπεω*, *to look*, p. 59.
Ora serrata. Lat. *ora*, *a bounaary*, and *serratus*, *serrated*, p. 21.
Ossicula auditus. Lat. *ossiculum*, *a small bone*, and *auditus*, *hearing*, p. 185.
Otalgia. Gr. *ους*, *the ear*, and *αλγος*, *pain*, p. 242.
Othæmatoma. Gr. *ους*, *ear*, and *αἱμα*, *blood*, p. 216.
Otolith. Gr. *ους*, *the ear*, and *λιϑος*, *stone*, p. 198.
Otoscope. Gr. *ους*, *ear*, and *σκοπεω*, *to look*, p. 209.

Palpebral. Lat. *palpebra*, *eyelid*, p. 33.
Pannus. Lat. *pannus*, *a cloth*, p. 105.
Panophthalmitis. Gr. *πας*, *all*; *οφϑαλμος*, *eye*, and *itis*, *denoting inflammation*, p. 119.
Papilla. Lat. *papilla*, *a nipple*, p. 33.
Patellaris. Lat. *patella*, *a dish* or *plate*, p. 24.
Pectinatum. Lat. *pectinatus*, *comb-like*, p. 16.
Phakitis. Gr. *φακος*, *lens*, and *itis*, *denoting inflammation*, p. 130.
Phlyctenule. Gr. *φλυκταινα*, *a pimple*, p. 95.
Phosphènes. Fr. *phosphène*, p. 170.
Photophobia. Gr. *φως*, *light*, and *φοβος*, *dread*, p. 95.
Photopsia. Gr. *φως*, *light*, and *οψις*, *vision*, p. 170.
Pinguecula. Lat. *pinguis*, *fat*, p. 97.
Pinna. Lat, *pinna*, *a kind of sea-mussel*, p. 176.
Polycoria. Gr. *πολυς*, *many*, and *κορη*, *pupil*, p. 118.

ACUTE CATARR
quite common. H
exposure to cold
water to run into e
constitutional dise
measles, small-pox,
of "nasal douche,"
instrument probabl
of the water thro
into tympanum.
starts from faucial
but may sometime
canal. *Symptoms*
tinnitus; impairm
swelling, and bulg
pani; catarrh of
tube; fever, and,

Tapetum. Lat. *tapete*, *a carpet*, p. 17.
Tectorian. Lat. *tectorius*, *covering*, p. 201.
Tinnitus. Lat. *tinnitus*, *a ringing*, p. 220.
Trachoma. Gr. τραχωμα, *a roughness*, p. 94.
Tragus. Gr. τραγος, *a goat ; because hairs like a goat's beard sometimes grow on this part* (?), p. 177.
Trichiasis. Gr. τριχιαω, *to show hairs*, p. 156.
Tylosis. Gr. τυλος, *a callus*, p. 154.
Tympanum. Lat. *tympanum*, *a drum*, p. 183.

Umbo. Lat. *umbo*, *a boss*, *as that of a shield*, p. 181.
Unguis. Lat. *unguis*, *a finger-nail*, p. 103.
Utricle. Lat. *utriculus*, *a small leathern bottle*, p. 107.
Uvea. Lat. *uva*, *a bunch of grapes*, p. 12.

Vitreous. Lat. *vitreum*, *glass*, p. 24.
Vorticose. Lat. *vorticosus*, *full of eddies*, p. 14.

Xerophthalmia. Gr. ξηρος, *dry*, and οφϑαλμος, *eye*, p. 96.
Xanthoma. Gr. ξανϑος, *yellow*, p. 250.

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Arteries of eye, 28.
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to take cold will assist in relieving chronic aural catarrh. Attention to skin, daily sponge bathing and frictions, Turkish baths, etc., are very useful. Treatment of pharynx and nose very necessary. Injections of the naso-pharyngeal space by a long syringe made for the purpose, are useful to dislodge collections of matter, if for nothing else. Various solutions are used in the syringe, of which those of salt and chlorate of potash are most common. Nasal douche dangerous, as it has often caused acute inflammation of middle ear, even when all precautions had been observed in its use. Better to wash out nostrils with Davidson's syringe by *gentle and intermittent* current. Same solutions are used as in post. nares syringe. The applications to be made to the nasal and pharyngeal mucous membrane will, of course, vary with different practitioners. A gargle is a matter of individual choice. Saturated sol. chlorate of potash as good as any for ordinary purposes. Tröltsch's method of gargling is useful as *gymnastic exercise* for muscles of tube, aside from its effect on mucous membrane :—The gargle is held in back part of mouth, the head thrown well back, and the nostrils closed with the fingers; swallowing motions are then performed without actually swallowing the solution. Eustachian catheter is used for treating tube and tympanic cavity. Simple air blown through it is most universally useful. Steam,

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BIBLIOGRAPHY.

Handbuch der Anatomie des Menschen. J. Henle, Braunschweig, 1866.
Traité D'Anatomie. Ph. C. Sappey, Paris, 1872.
Handbuch der Lehre von den geweben des Menschen und der Thiere. S. Stricker, Leipsig, 1872.
Handbuch der gesammten Augenheilkunde. Graefe und Saemisch, Leipsig, 1874.
Gray's Anatomy, Descriptive and Surgical. Philadelphia, 1862.
Physiology of Man. Austin Flint, Jr., N. Y., 1874.
Anatomie und Physiologie des Auges. Heinrich Müller, Leipsig, 1872.
Treatise on Diseases of the Eye. Dr. Carl Stellwag (von Carion). Translated by Drs. Roosa, Hackley and Bull, N. Y., 1873.
Diseases of the Eye. J. Soelberg Wells, Am. Ed., *Phila., 1873.*

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fractions. For example, a len
is only $\frac{1}{24}$ as strong as the un
must be designated by $\frac{1}{24}$; a
cus is $\frac{1}{10}$, etc. In making ca
always to add or subtract frac
convenient. In the metric sy
weak lens, of one metre foca
called a dioptric (D). It is ab
lens of the old system. The
multiples of the unit. Calc
made, as we deal only with wh
example, a lens twice as strong
of two dioptrics, 2 D ; one thr
is 3 D ; one half as strong is
thalmoscopes and cases of tri
numbered according to both sy

Page 112. *Keratitis bullosa*
corneal inflammation whose cau
characterized by a localized
deeper layers of the cornea, o
parent vesicle forms and break
ficial ulcer. After the breaki
repair is rapid. The disease is
pain and great spasm of the lid
intra-ocular pressure is increas
slight tendency to suppuration
cornea, or to invasion of ne
There seems to be some conne
disease and acute glaucoma.
tendency to relapses. Treatme
ing of the vesicle, scarificatio
atropine, eserine, heat, paracen
if the intra-ocular pressure is

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action is shown by fro
mouth of the follicle.
ceeded, the hair, in ca
can be extracted with

Page 158. *Ephidro*
tion of the sweat-glan
itching and biting sen
inflammation of the sk
It is difficult of cure.
Chromhidrosis is a
oration of the skin of th
and capable of being w
water. Seen chiefly i
supposed by some aut
simulation.
Xanthelasma, *Xanth*
pears as peculiar yellow
on the skin of the ey
upper lid

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Subconjunctival tissue, 9.
Subdural space, 6.
Subvaginal space, 6.
Suction of cataract, 75.

duction is better in the latter position than in the former.

The chief reason why a tuning-fork held on the teeth or the vertex is heard better in the deafer ear, when the deafness is due to disease in the conducting portions, is, that the escape of the vibrations outward through the drum and auditory canal is *obstructed*,—more of them are thrown back upon the nerve, and the latter thus perceives the sound intensified. If, in such a case, the meatus is also plugged by the finger, the sound will be still further increased on that side. It is thought that when plugging the canal in this way does *not* intensify the sound, this fact is proof that the auditory nerve is involved : this view is not held by all surgeons.

The tuning-fork held on either parietal protuberance is heard better *in the opposite ear* in a normal case. This is still more noticeable if that ear is the seat of disease confined to the conducting portions.

Testing the hearing in one-sided deafness requires great care, owing to the difficulty in excluding the good ear. The following methods are useful :

Stop the better ear, and direct it toward the source of sound ; then test the hearing, with the deaf ear alternately open and closed : if there is any difference found by the two tests, the balance is credited to the worse ear. [Dennert & Lucae, Berlin, 19th cent.]

Stop the affected ear, and pass a vibrating tuning-fork back and forth alongside of it. If the *sound is not* increased as the fork nears the

Tinnitus, 220.
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  " groove, 179.
  " plexus, 188.
  " ring, 179.

Emphysema sometimes occurs over the mastoid process, the air escaping by way of the middle ear and mastoid cells, through a congenital fissure in the bone.

Page 216. *The auricle* is subject, also, to erythema, erysipelas, herpes, syphilitic eruptions, frost-bite, etc. If any cold fluid is used in treatment, it should not be allowed to run into the auditory canal, lest it may excite inflammation of the deeper parts of the ear. In cases of frost-bite, it is necessary to guard against too sudden reaction: the auricle should be bathed with very cold water at first, and warmer applications made gradually.

Page 228. Sometimes *exudations of serous fluid into the tympanum* (hydro-tympanum) occur without any active inflammatory symptoms. The patient complains of deafness, a sense of stiffness, and, perhaps, of pressure. On inspection, the level of the fluid may be seen through the drum-head, and this may alter with a change in position of the patient's head; or bubbles of fluid may be seen behind the membrane; or there may be nothing evident save some slight alteration in the translucency of the part. Inflation, paracentesis, and attention to the throat and general condition are the chief means of treatment.

Page 235. *Pulsation of the membrana tympani, without perforation*, has been observed in rare instances. A few cases have been reported where the *pulsation* seemed to depend upon a vascular

Zone of Haller, 10.
Zona pectinata, 200.

GLOSSARY.

The definitions of the words given below can be found by means of the page-references and index.

Amaurosis. Gr. *αμαυροω*, *to render obscure*, p. 141.
Amblyopia. Gr. *αμβλυς*, *dull*, and *οψις*, *vision*, p. 141.
Ametropia. Gr. *α*, *privative ; μετρον*, *measure ; οψις*, *vision*, p. 162.
Ampulla. Lat. *ampulla*, *a flask*, p. 193.
Anchyloblepharon. Gr. *αγκυλωσις*, *a stiffening*, and *βλεφαρον*, *eyelid*, p. 97.
Annulus tympanicus. Lat. *annulus*, *a ring*, and *tympanicus*, *tympanic*, p. 179.
Anopsia. Gr. *ανα*, *without*, and *οψις*, *vision*, p. 141.
Antrum. Lat, *antrum*, *a cave*, p. 189.
Aphakia. Gr. *α*, *privative*, and *φακος*, *lens*, p. 168.
Arcus senilis. Lat. *arcus*, *a bow*, and *senilis*, *senile*, p. 39.
Asthenopia. Gr, *ασθενης*, *weak*, and *οψις*, *vision*, p. 162.
Astigmatism. Gr. *α*, *privative*, and στιγμα, *a point*, p. 166.
Auricle. Lat. *auricula*, *the external ear*, p. 176.